Final Report

A project under the Canada
New Brunswick Conservation
and Renewable Energy
Demonstration Program

Enerplan consultants ltd.
energy planning and engineering

33/64

RETROFIT OF THREE MUSEUMS

ENERPLAN CONSULTANTS PLAN
February, 1985

CREDA PROJECT # 2052

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Canada/New Brunswick Conservation and Renewable Energy Demonstration Program

The Conservation and Renewable Energy Demonstration Program Program is administered in New Brunswick by the Energy Secretariat and managed jointly with Energy, Mines and Resources Canada. The Program is designed to help demonstrate promising conservation and renewable energy technologies, to develop public awareness and understanding of these technologies, and to create employment in new or existing industries.

Through over 100 demonstration projects in New Brunswick, a wide variety of conservation and renewable energy technologies have proven to be technically sound and economically attractive. These demonstration projects should now provide a catalyst for commercialization and lead to widespread adoption of many of these proven technologies.

This final report is based on a project which was financially supported by the Energy Demonstration Program. For further information on other demonstration projects funded in New Brunswick under this program, contact:

Conservation & Renewable
Energy Division
Energy Secretariat
P.O. Box 6000
Fredericton, N.B.
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Programme Canada/Nouveau-Brunswick de démonstration des économies d'énergie et des énergies renouvelables

Le Programme de démonstration des économies d'énergie et des énergies renouvelables est administré au Nouveau-Brunswick par le Secrétariat à l'énergie, en collaboration avec Energie, Mines et Ressources Canada. Ce programme tente d'abord de vérifier la fiabilité des techniques de conservation d'énergie, d'accroître la sensibilité du public envers ces techniques et, enfin, de favoriser la création d'emplois au sein des industries nouvelles ou déjà existantes.

Un grand nombre de projets de démonstration se sont avérés à la fois techniquement réalisables et économiquement attrayants.

Le succès ainsi rencontré encourage la commercialisation des procédés les plus accessibles. Cela entraînerait certes l'adoption d'un grand nombre de ces techniques par les propriétaires de domiciles et par l'industrie privée.

Ce rapport final est basé sur un projet qui a reçu une aide financière du Programme de démonstration. Pour de plus amples renseignements, communiquez avec la:

Division des économies d'énergie
et des énergies renouvelables
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D I S C L A I M E R

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D E N I D E R E S P O N S A B I L I T E

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1.0 Executive Summary

This energy demonstration project involved the use of modern technologies to retrofit three museums in New Brunswick which vary in size and complexity of energy consuming systems. Restigouche Gallery was refitted with triple glazed windows, an air lock entry, an air to air heat pump and destratification fans. Moncton Museum was made an all electric facility, thus removing the electric demand charge, by replacement of oil fired boilers with air to air heat pump and electric terminal reheat coils. Grand Manan Museum was retrofitted with R40 insulation in the attic, new double glazed windows and a new lighting design.

The objectives of the project were to demonstrate technologies presently available to improve energy efficiency in buildings, to demonstrate the advantages of an all electric rate in New Brunswick where no demand is charged and to show the feasibility of retrofits of this type. All the retrofits have been successfully completed. The Moncton Museum is showing a substantial saving by going to the all electric rate. Feasibility of retrofits of this type depend on the existing efficiencies and operating hours of the buildings retrofitted and have been shown to vary from 5.9 to 16.3 years in terms of simple payback.

Technologies used in these buildings are readily adaptable to many residential size business facilities, particularly where electrical demand costs are a problem.

1.0 SOMMAIRE-RECOMMANDATION

Ce projet de démonstration énergétique faisait appel à des technologies modernes pour rénover trois musées du Nouveau-Brunswick dont les systèmes de consommation énergétique variaient en dimensions et en complexité. A la Gallerie Restigouche, on a installé des fenêtres à triple vitrage, un vestibule-sas d'air, une pompe à chaleur air-air et des ventilateurs de déstratification de l'air. Au musée de Moncton, on a installé un système totalement électrique, éliminant ainsi la prime d'électricité, en remplaçant des chaudières au mazout par une pompe à chaleur air-air et des serpentins de réchauffage électriques. Les rénovations du musée de Grand Manan ont consisté à isoler le toit à R-40, à installer des fenêtresà double vitrage et à modifier le système d'éclairage.

Ce projet avait pour objet de démontrer des technologies pouvant actuellement être utilisées pour améliorer le rendement énergétique dans les bâtiments, de démontrer les avantages, au Nouveau-Brunswick, du tarif tout-électrique qui ne comporte aucune prime, et enfin de montrer la faisabilité de ce genre de rénovations. Tous les travaux ont été achevés de façon profitable. Le musée de Moncton, dont le système est maintenant tout-électrique, présente des économies importantes. La faisabilité de ce genre de rénovations dépend de l'efficacité des systèmes existants et des heures d'utilisation des bâtiments rénovés. A ce chapitre, on a pu observer des différences en ce qui a trait à la période de recouvrement qui variait de 5,9 à 16,3 ans.

Les technologies utilisées dans ces bâtiments peuvent s'adapter facilement à diverses sortes d'installations commerciales de dimensions résidentielles, particulièrement là où le coût des primes d'électricité sont une source d'ennuis.

2.0 Introduction

2.1 General

The province of New Brunswick has 24 museums scattered across it. The cost of operating a museum has risen greatly due to the rise in energy costs.

Enerplan Consultants Ltd. prepared and submitted a proposal for an energy demonstration project on three typical museums in different communities in the province of New Brunswick in April 1982. The primary objective of the proposal was to demonstrate feasible methods of reducing operating costs of museums. The proposal was accepted by the Energy Secretariat for funding under the Conservation and Renewable Energy Demonstration Agreement and was initiated in January 1983.

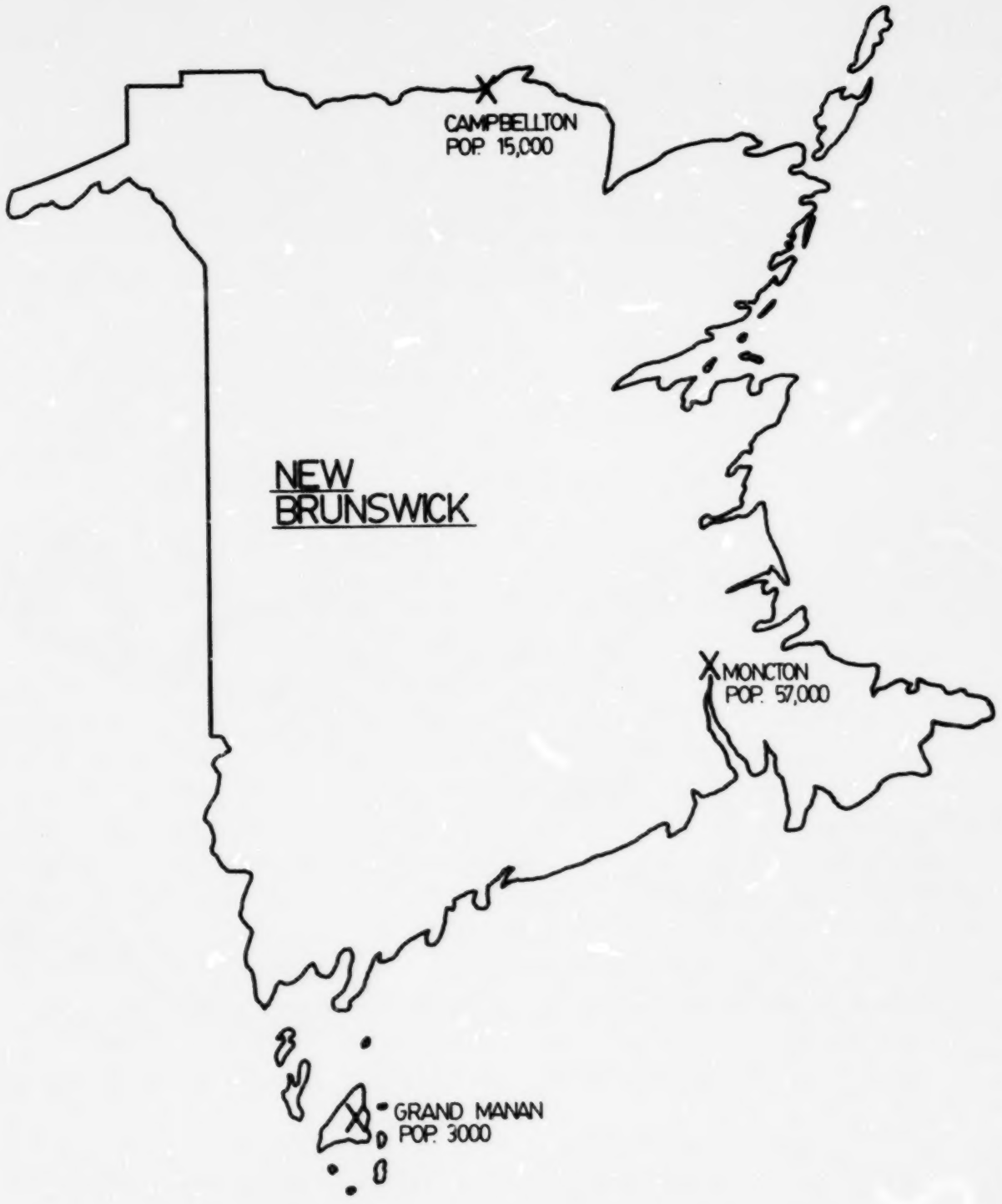
The initial stage of the project was to monitor the museums and detect any areas in need of improvement. The retrofit was then done to the facilities and the final stage was to follow up the retrofit with a monitoring system for one year. These before and after values were then compared and conclusions drawn as to the economic paybacks of the project.

2.2 Site Selection

The choice of three museums out of 24 that are located in New Brunswick was done while keeping in mind the following selection criteria:

(1) geographical location
(2) population of community
(3) funding by the community

The sites selected, ie, Restigouche Gallery, Campbellton; Grand Manan Museum, Grand Manan; and Moncton Museum Inc., Moncton, represent a good cross-section of types of museums and are all in different areas of the province. Refer to Figure 1.



GEOGRAPHIC DISTRIBUTION OF MUSEUMS

FIG. 1

3.0 Description of Demonstration

3.1 Grand Manan

This museum is open only in the summer for the public but is kept partially heated during the winter for preservation of building and contents. Batt insulation was therefore added to the attic to reduce heat loss (RSI-7, R40).

Lighting in some areas was incandescent. These were changed to fluorescent which reduced electrical consumption while maintaining good color rendition and atmosphere.

Detailed information can be found in Appendix A.

3.2 Restigouche Gallery

Restigouche Gallery, before retrofit, had problems with excessive air leakage and heat loss through doors and windows. To alleviate this problem, new triple glazed windows were installed and an air lock entry with a second overhead door was constructed at the receiving entrance. Air leakage tests were done before and after air sealing the building with caulking, weatherstripping and insulation to ensure a reduction in infiltration.

To prevent damage to artifacts the humidity in a museum must be kept fairly constant and the operators in the Restigouche Gallery required 55% relative humidity. A new humidifier was installed to provide the necessary humidification.

Existing heating and cooling were by electric furnace and coils and a split system air conditioner. These were replaced by a 7½ ton heat pump with auxiliary electric heating.

Ductwork that previously ran around the perimeter of the building was abandoned and short circuited to the diffuser locations thereby cutting down the length of ductwork and reducing duct resistance to decrease fan power requirement.

Detailed information can be found in Appendix B.

3.3 Moncton Museum

Moncton Museum required the most extensive retrofit of the three buildings. The existing heating, cooling and humidifying systems were made up of two oil fired boilers for space heating, one boiler for humidification and a chilled water split system air conditioner with an air cooled condenser. Heating/cooling distribution was by constant volume air at 55°F which was reheated as necessary by hot water terminal reheat coils in each zone. Relative humidity was controlled to maintain 55 per cent.

The retrofit removed all oil fired boilers and converted the systems to all electric heating, cooling and humidifying. A combination of a new water cooled condensing unit and a new air cooled condensing unit were installed so that heat rejected in cooling or dehumidifying could either be used for heating in zones requiring heat or be rejected outside. It was calculated that mechanical cooling (sensible) was less costly than free cooling and humidifying during most of the year. Controls for free cooling with outside air were left in place to be used when humidifying was not necessary and for emergency use. Hot water terminal reheat coils were now used to distribute rejected heat from the water cooled condenser (heat pump). Electric reheat coils were installed downstream from the hot water reheat coils and were controlled to work as auxiliary heaters if the hot water coils couldn't handle the load. A new electric humidifier was installed to replace the old humidification boiler. The old air conditioning unit was kept for auxiliary summer cooling.

The changeover to an all electric building has changed the electric rate from rate 72 with demand charge to rate 71 without demand charge.

Details of the retrofit can be found in Appendix A.

4.0 Monitoring

4.1 Observations during design

Conversion to all electric heating is often done by installation of baseboard electric heaters. This was considered for the Moncton Museum but was not used due to the potential problem of hot spots too close to valuable paintings. The use of reheat coils allowed more precise control of the distribution of heat and relative humidity.

4.2 Monitoring Equipment Used

Invoices from N. B. Power and from oil suppliers were the main means of monitoring. Moncton Museum has its own hygrothermograph and readings have been taken in the building before and after the retrofit. Restigouche Gallery was also supplied with a hygrothermograph after the retrofit and it is used occasionally to check temperature and relative humidity. An air leakage test was also done on Restigouche Gallery.

4.3 Performance of Retrofits

The Grand Manan Museum energy consumption data is incomplete at the time of this writing. Since operation of the facility is seasonal and the schedule is not constant from year to year, the comparative data is not considered useful. However, observation of the lighting systems shows an improvement and added insulation and double glazing has made the facility less drafty and more comfortable.

The Restigouche Gallery showed a 40.9% reduction in air infiltration at 50 pascals pressure differential. An electricity saving of 7.5 kilowatt hours per square foot occurred from December 1983 to November 1984 as compared to April 1982 to March 1983 and based on 4600 square feet. This amounts to a 27.7% reduction in electricity use. If adjusted according to centigrade degree days, the energy saving amounts to a 27.3% reduction (from 27.1 Kwh/ft.^{2} to 19.7 Kwh/ft.^{2})

The Moncton Museum now has better control of its temperature and humidity in each zone. Graphs from the hygrothermograph for two periods of the year are shown in the appendices for comparison. The energy savings in comparing November 1982 to October 1983 with December 1983 to November 1984 in terms of equivalent kilowatt hours amount to 48.9% reduction. If adjusted for degree days the saving is 56.4%. The equivalent kilowatt hours per square foot reduction is 35.9 based on 13200 square feet. (from 73.4 Kwh/ft.^{2} to 37.5 Kwh/ft.^{2})

Detailed records on energy consumption can be found in the appendices.

A summary of the energy consumption results is presented in the following table.

RESTIGOUCHE GALLERY				MONCTON MUSEUM			
Year	°C Days	$\frac{\text{Kwh}}{\text{ft.}^2}$	Adjusted Kwh/ft.^{2}	Year	°C Days	$\frac{\text{Kwh}}{\text{ft.}^2}$	Adjusted Kwh/ft.^{2}
Apr. 82 to Mar. 83	5466	27.1	27.1	Nov. 82 to Oct. 83	4072	73.4	73.4
Dec. 83 to Nov. 84	5431.1	19.6	19.7	Dec. 83 to Nov. 84	4770.1	37.5	32.0
REDUCTION		7.5	7.4	REDUCTION		35.9	41.4
% REDUCTION		27.7	27.3	% REDUCTION		48.9	56.4

5.0 Project Cost Accounting

5.1 Total Project Cost and Funding

The cost breakdown for this project is listed below.

Restigouche Gallery:		
Overhead Door & Glazing	$ 7,036.50	
Air Sealing	3,800.00	
Ductwork Modifications	5,750.00	
Heat Pump & Installation	18,100.00	
Destratification Fans	1,150.00	
	$35,836.50	$35,836.50
Moncton Museum:		
Mechanical Systems Modifications	$61,408.00	$61,408.00
Grand Manan Museum:		
Building Envelope Modifications	$ 4,227.75	
Lighting & Electrical Modifications	721.80	
	$ 4,949.55	$ 4,949.55
		$102,194.05
Engineering		8,000.00
Monitoring		10,000.00
Information Transfer		6,000.00
Final Report		4,000.00
		$130,194.05
CREDA Funding		$ 80,000.00
Museums' Contribution		
Restigouche Gallery	$13,091.96	
Moncton Museum	9,100.00	
City of Moncton	26,600.00	
Grand Manan Museum	1,402.09	
	$50,194.05	$ 50,194.05

5.0 Project Cost Accounting

5.2 Cost Benefit Analysis

Insufficient information is available for cost benefit analysis on the Grand Manan Museum.

Restigouche Gallery experienced a saving of $1,818 per year. In terms of simple payback ($\frac{\text{Capital Cost}}{\text{Saving /year}}$) the retrofit will pay for itself in approximately 20 years based on energy savings at current prices.

Moncton Museum showed a saving of $10,821 per year. Simple payback is approximately 5.7 years.

The other benefits not considered in simple payback include comfort level and relative humidity and temperature control. Graphs in the appendices show that an improvement has occurred due to the retrofits. This should contribute substantially to the preservation of museum artifacts.

See the appendices for energy cost tables.

6.0 Information Transfer

6.1 General

Interest in heat pump systems and all-electric systems has been generated by the retrofit projects in Moncton and Campbellton, N. B. A number of inquiries have been received from interested individuals and several groups of people have toured the facilities.

A display featuring the Moncton Museum was presented at the "Municipal Energy Conference" held in Fredericton, N. B. in November of 1984.

A project summary sheet was prepared by the Energy Secretariat and has been circulated to a number of people throughout New Brunswick.

7.0 Conclusions and Recommendations

7.1 Conclusions

Fluorescent lighting has been used successfully to replace incandescent lighting in a museum. Improvements have been made by better color rendition and decreased costs of operation.

Improvements to building envelopes by installation of new windows, more insulation and a second door to make an air lock entry have reduced drafts and improved comfort levels.

Heat pumps have been used to demonstrate a highly efficient method of heating and also a means of redistributing heat within a building.

7.2 Recommendations

As the result of this energy demonstration project we recommend the following:

1) A detailed study should be undertaken to determine feasibility of energy retrofits in museums.
2) To maintain humidity levels required by museums recirculation of air with mechanical cooling and heat reclaim should be considered rather than using free cooling by outside air.
3) New lighting technology should be considered in place of incandescent lighting with care taken to provide good color rendition.

APPENDIX A

GRAND MANAN MUSEUM

DETAILS OF RETROFIT

May 17, 1983

For: Grand Manan Museum,
Grand Harbour,
Grand Manan, N.B.

a) To supply and reglaze ten windows in front of museum with sealed units including heat mirror and grills

b) For Nature Center and store room-to supply and install three new casement windows with heat mirror and one panel operating

c) Nature Center door - to weatherproof and supply and install a sealed glass unit in existing door. Adjust existing storm door

d) Washrooms - to supply and install 2 casement windows with heat mirror and one panel operating.

e) Front doors - to supply and install double 2" Futura storm doors with full screen and top and bottom panels operating

Price includes labour, all materials and taxes and is in effect for 30 days. All products are guaranteed for five years, workmanship for one year. Casement windows are available in three colours, storm doors in nineteen colours.

TOTAL PRICE $4227.75

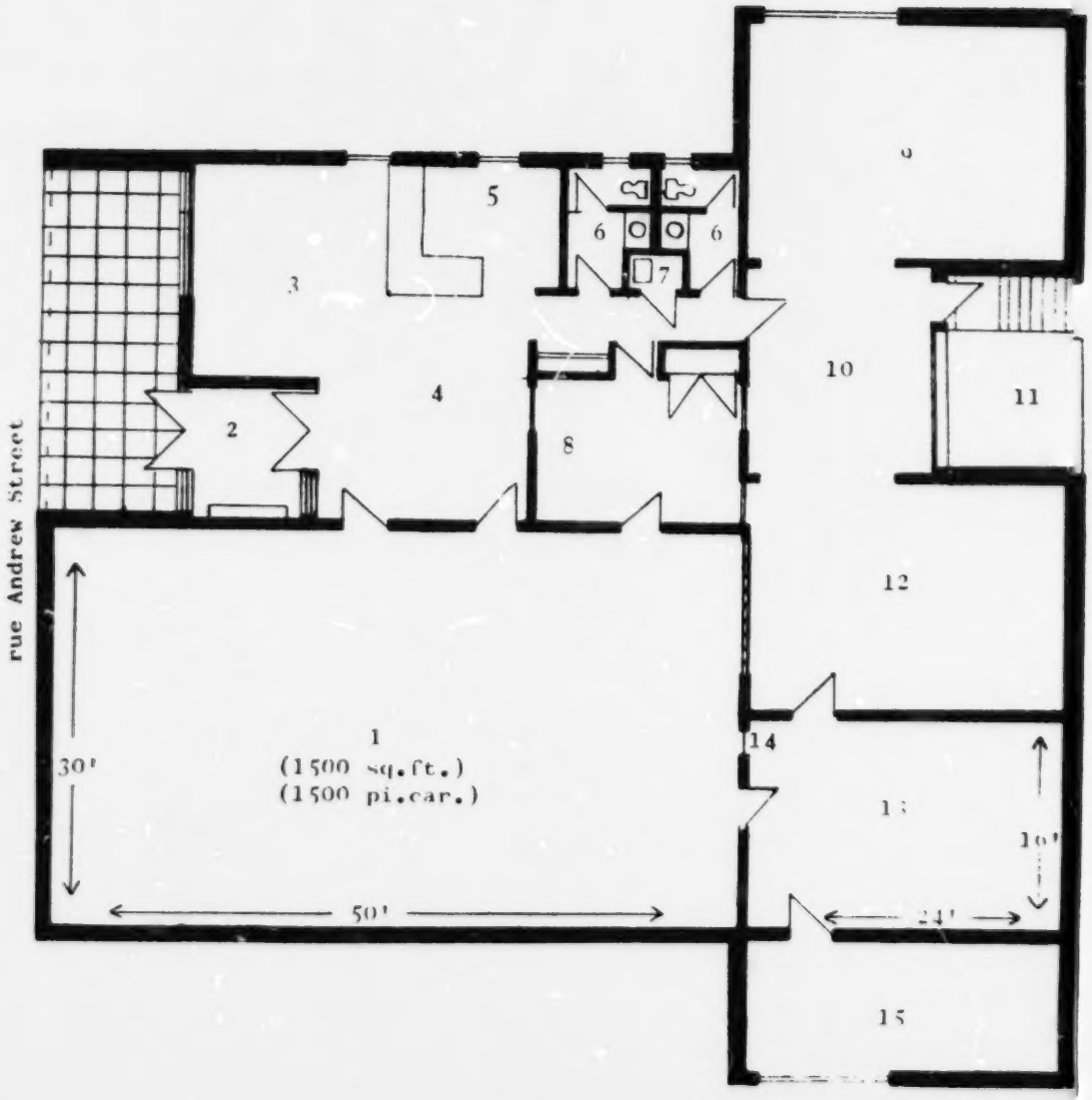
APPENDIX B

RESTIGOUCHE GALLERY

DETAILS OF RETROFIT

RESTIGOUCHE GALLERY

1. Grande salle d'exposition
   Exhibition hall
2. Entrée
   Entry
3. Attente
   Waiting
4. Foyer
   Lobby
5. Réception
   Reception
6. Toilettes
   Washrooms
7. Concierge
   Janitor
8. Bureau
   Office
9. Entrepot
   Storage
10. Livraison
    Receiving
11. Embarcadère
    Loading dock
12. Atelier
    Workshop
13. La Petite Galerie
    The Small Gallery
14. Projection
15. Salle des machines
    Mechanical Room



Windows (Murray's Auto Top)

Replace all existing windows with sealed triple glazing tinted on one side.

Rear Entry (Murray's Auto Top)

Fill existing steps and install new concrete steps with foundation and handrail on both sides. Install new 10'-0" x 10'-0" insulated steel overhead door with chain hoist and 3'-0" x 6'-8" insulated steel mandoor with glazing above mandoor to match existing entry. Frame wall around doors and finish outside with cedar to match existing, insulate wall cavity and finish interior with gyprock.

Heat Pump (Mike Melanson Refrigeration)

Supply and install one Carrier 7½ ton split system heat pump, complete with controls, status panel, filters and 27 kw auxiliary heaters. Supply and install one Nortec Steam humidifier (17#/hr) and re-wire two of existing duct heaters. Relocation of duct heaters and mounting of humidifier manifold in ductwork by others. Supply new low leakage fresh air damper to be installed by others. Supply and install new 7-day time clock to shut down washroom exhaust fan and close fresh air damper during unoccupied hours.

Duct Modifications (Key Mechanical)

Modify ductwork and install new supply air grilles as per sketch SK-1. Install acoustic insulation in supply and return plenums and make connection to heat pump. Mount new damper and steam manifold and relocate two duct heaters.

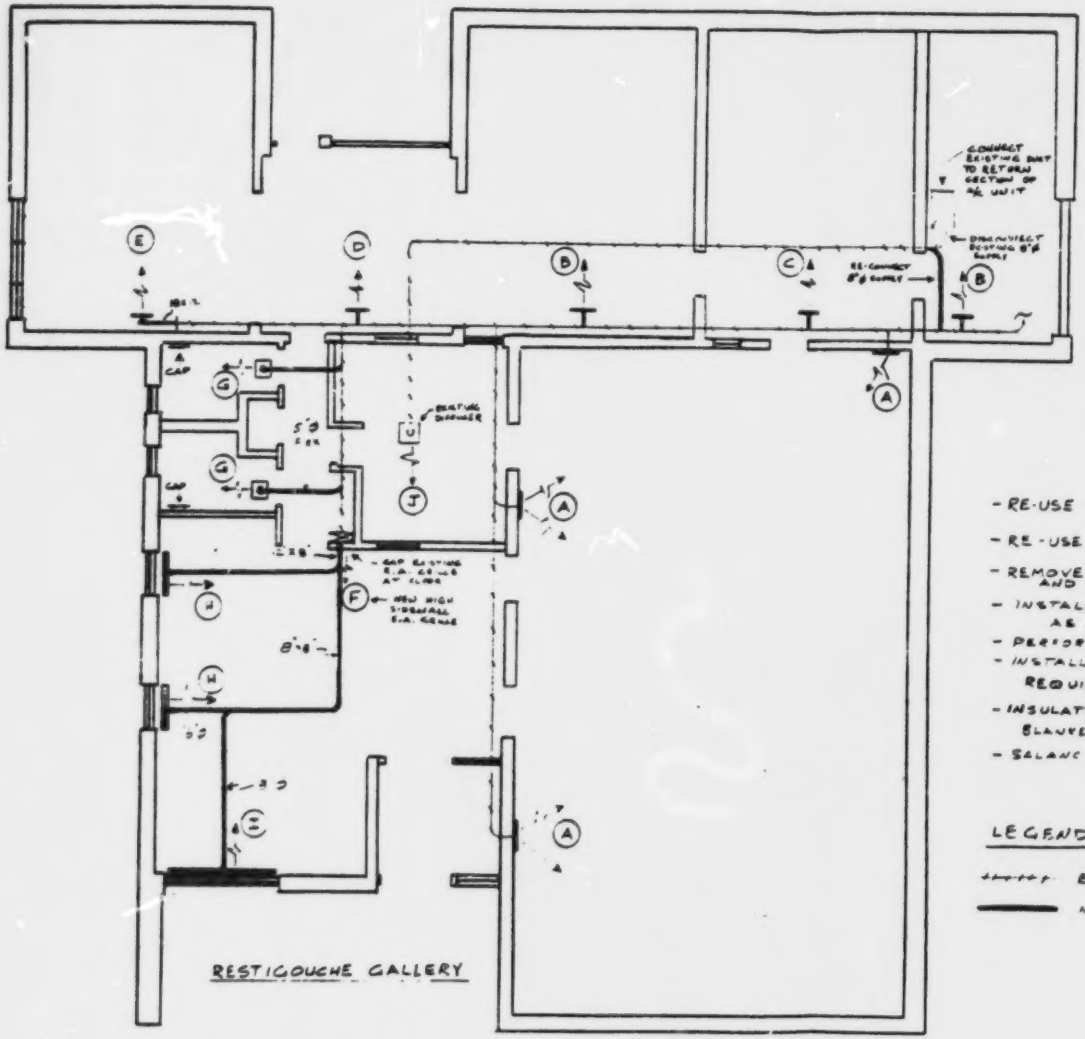
Air Sealing and Weatherstripping (En-Spect Services)

Provide air sealing of the following:

- Around front entry doors.
- Around rear entry doors.
- Around recessed lighting fixtures.
- All electrical outlets and switches on exterior walls.
- All cracks along roof line and baseboards.
- All electrical and plumbing penetrations through the building envelope.

Weatherstrip all the following:

- Front entry doors
- Rear entry doors
- All openable windows
- Adjust existing weatherstripping or rear loading door.



GRILLE/DIFFUSER SCHEDULE				
MARK	MODEL	SIZE	CFM	ACCESSORIES
A	SC-EJ	16"x 6"	265	VOLUME CONTROL
B	SC-EJ	10"x6"	200	" "
C	SC-EJ	8"x6"	175	" "
D	SC-EJ	14"x3"	350	" "
E	SC-EJ	20"x3"	400	" "
F	SC-EJ	12"x6"	150	" "
G	SNSV	5"ø	60	" "
H	CAA	4'-0"-2 5/16"	100	MOUNTING FRAME
I	CAA	3'-0"-2 5/16"	175	" "
J	EXISTING	8"ø	225	—

NOTES

- RE-USE EXISTING RETURN DUCT AS NEW SUPPLY
- RE-USE EXISTING U/G SUPPLY DUCT AS NEW RETURN
- REMOVE ALL GRILLES FROM EXISTING RETURN DUCT AND CAP OPENINGS (2/3)
- INSTALL NEW SUPPLY GRILLES AND DIFFUSERS AS PER SC-EDJ-S
- PERFORM ALL CUTTING & PATCHING AS REQUIRED
- INSTALL STEEL FRAME HINGED ACCESS DOORS AS REQUIRED TO COMPLETE THE INSTALLATION
- INSULATE ALL SUPPLY DUCTS ABOVE CEILING WITH 1" BLANKET TYPE VAPOR BARRIER INSULATION.
- BALANCE SYSTEM TO WITHIN 10% OF AIRFLOW SPECIFIED

LEGEND

EXISTING DUCT

NEW DUCT

RESTIGOUCHE GALLERY CAMPBELLTON, N.B.	
DUCT MODIFICATIONS	
DRN. BY CMT SCALE: 1/8"=1'-0"	SK-1

AFTER RETROFIT

AIR LEAKAGE TEST REPORT

IDENTIFICATION

- CLIENT ENERPLAN CONSULTANTS LTD.
- ADDRESS RESTIGOUCHE GALLERY CAMPBELLTON N.B.
  39 ANDREW STREET
- PHONE (H) _____ (W) _____
- TECHNICIAN HOLT/O'KEEFE

BUILDING DESCRIPTION

- APPROX. CONSTRUCTION DATE: 1975
- BASEMENT? [ ] YES [X] NO [ ] PARTIAL
- VENTILATION SYSTEM [ ] NONE HVAC
- INTERIOR HEATED VOLUME 1716 m^3
- HOUSE STYLE [ ] 1 STOREY [ ] 1 1/2 [ ] 2 [ ] 2 1/2 [ ] 3 [ ] SPLIT-LEVEL [ ] BI-LEVEL

BEFORE

PRE-RETROFIT TEST

[ ] NEW HOUSE [X] RESEARCH

- DATE 04/07/83 TIME 10:00 AM PM
- TEMPERATURE: IN 24 °C OUT 35 °C
- WIND (VEL. AND DIR.) NNW Gusts to 30KM
- AIR PRESSURE 101 Kpa

PRESSURE (PA)	FLOW (l/s)
60	31.00
55	
50	26.00
45	
40	24.50
35	
30	20.00
25	
20	14.33
15	
10	8.66

N = 0.702
C = 0.105
COR = 0.9969

ELA SQ. CM 2100
ELA SQ. FT 2.2596

AIR CHANGES/HR @ 50 pa: 3.47

AFTER

POST—RETROFIT TEST

[ ] NEW HOUSE [X] RESEARCH

- DATE 06/07/83 TIME 3:30 PM
- TEMPERATURE: IN 24 °C OUT 14 °C
- WIND (VEL. AND DIR.) W at 17-19 KM
- AIR PRESSURE 101.43 Kpa

PRESSURE (PA)	FLOW (l/s)
60	15.23
55	
50	13,71
45	
40	11.40
35	
30	10.76
25	
20	8.80
15	
10	5.466

N = 0.548
C = 0.096
COR = 0.9924

ELA SQ. CM 1300
ELA SQ. FT 1.3988

AIR CHANGES/HR @ 50 pa: 1.72

HOUSE CONDITION

- VENTS [ ] OPEN [ ] SEALED
- FIREPLACE [ ] CLOSED [ ] BLOCKED [ ] SEALED
- FURNACE [ ] OPEN [ ] SEALED

RETROFIT RESULTS

EQUIVALENT LEAKAGE AREA (ELA)

BEFORE .21m^2 AFTER .13m^2

40.9 % REDUCTION ACHIEVED

COMMENTS:

RETROTEC 1982

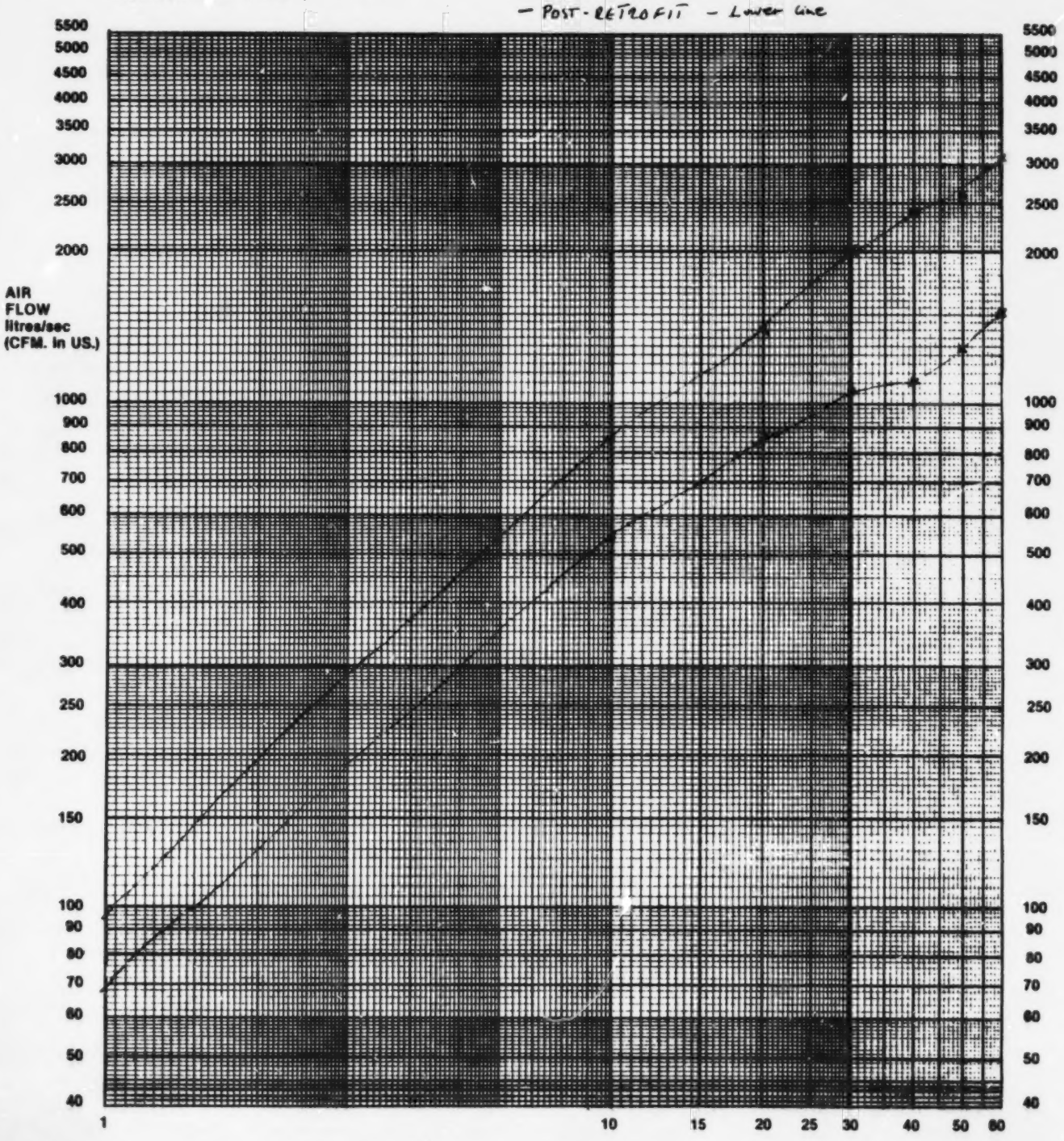
AIR LEAKAGE PROFILE

RESTIGOUCHE GALLERY

Address 39 ANDREW STREET

CAMPBELLTON, N.B.

– PRE-RETROFIT – Upper line
– POST-RETROFIT – Lower line



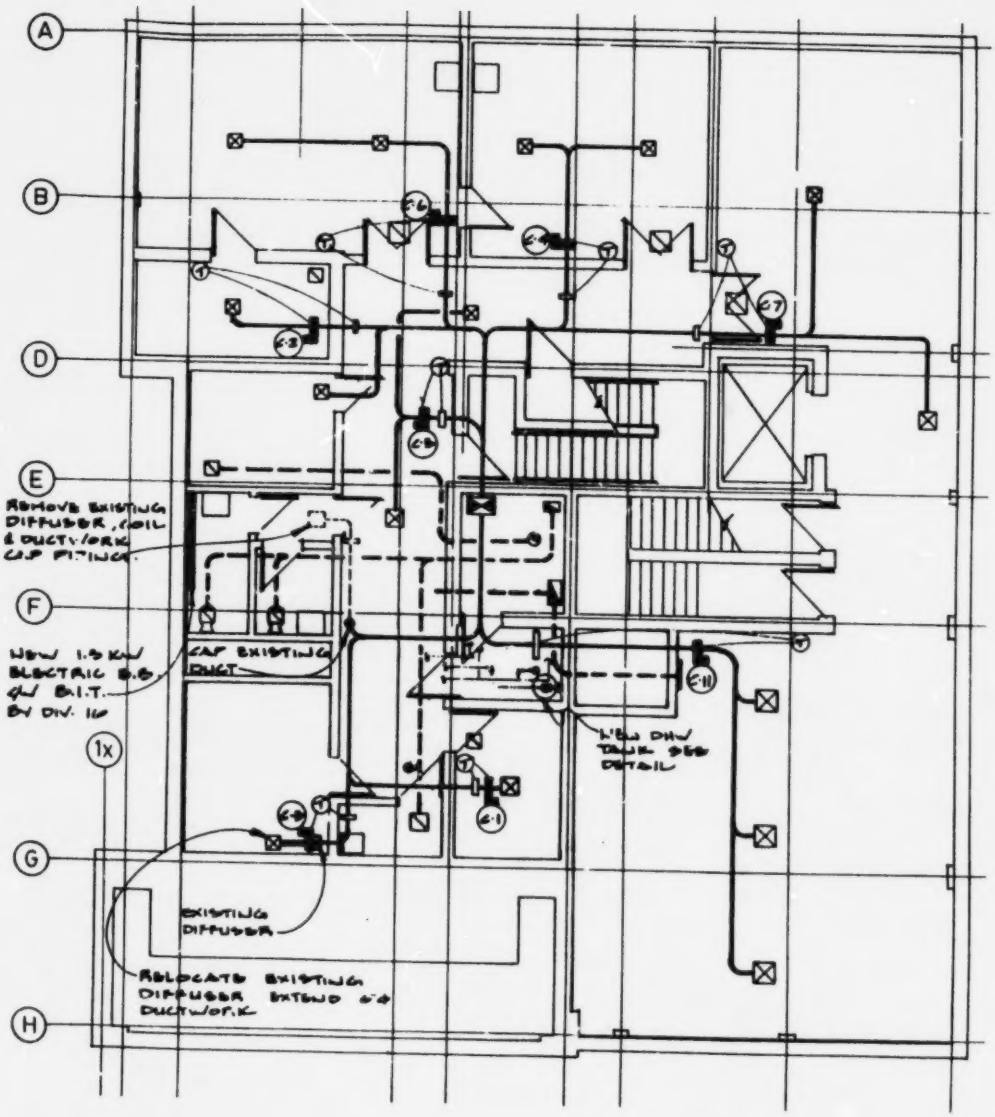
PRESSURE DIFFERENCE ACROSS BUILDING ENVELOPE

(PASCALS)

APPENDIX C

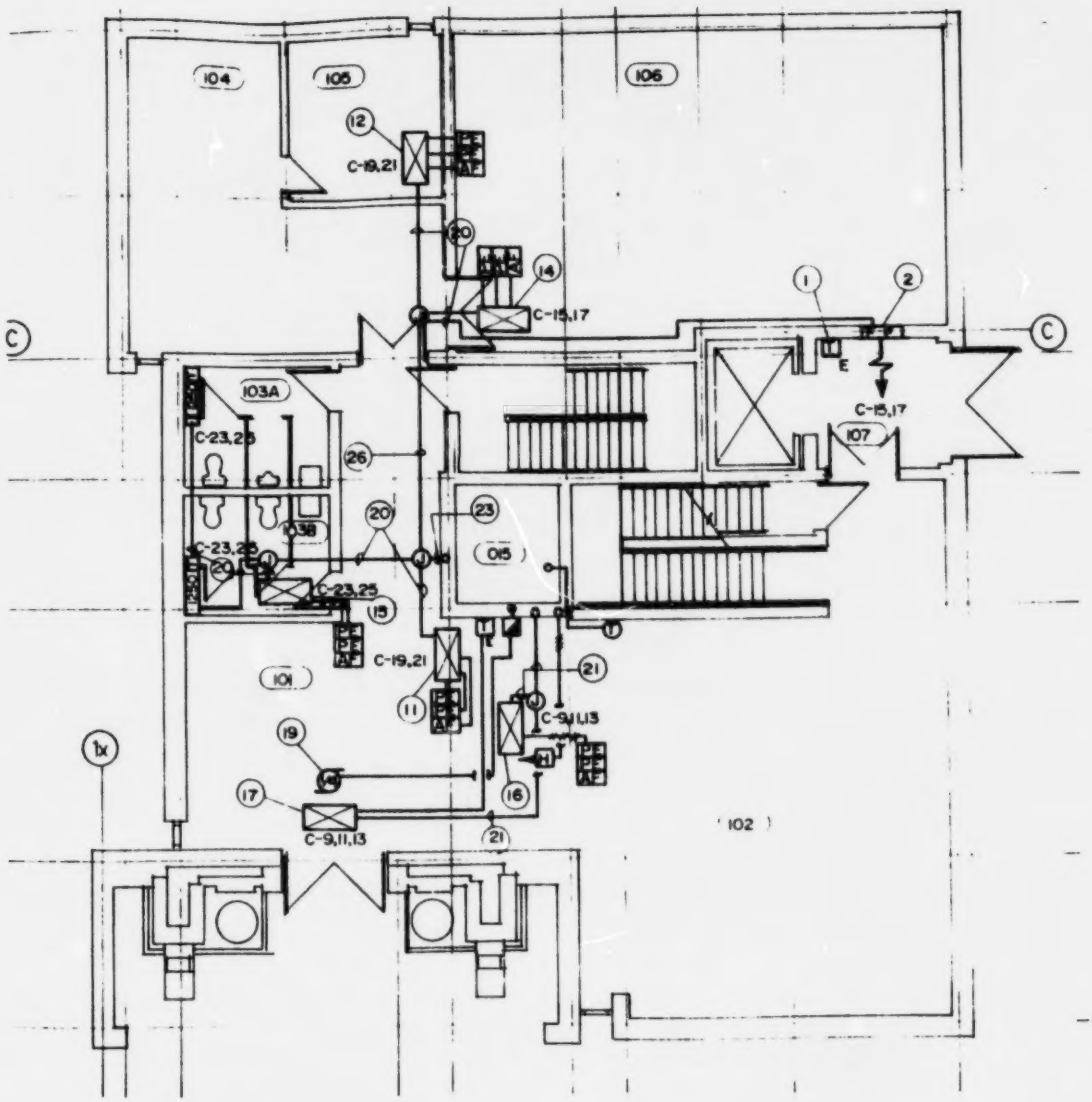
MONCTON MUSEUM

DETAILS OF RETROFIT

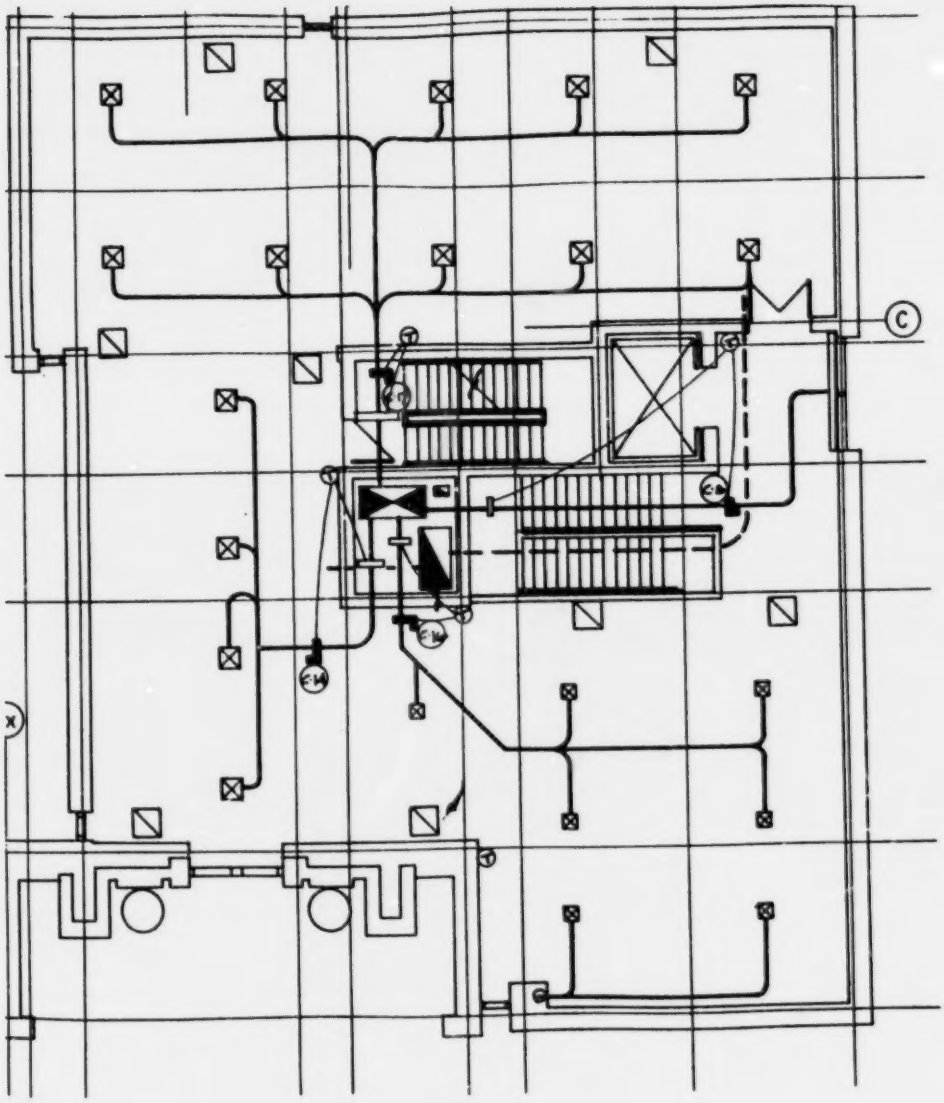


BASEMENT FLOOR PLAN

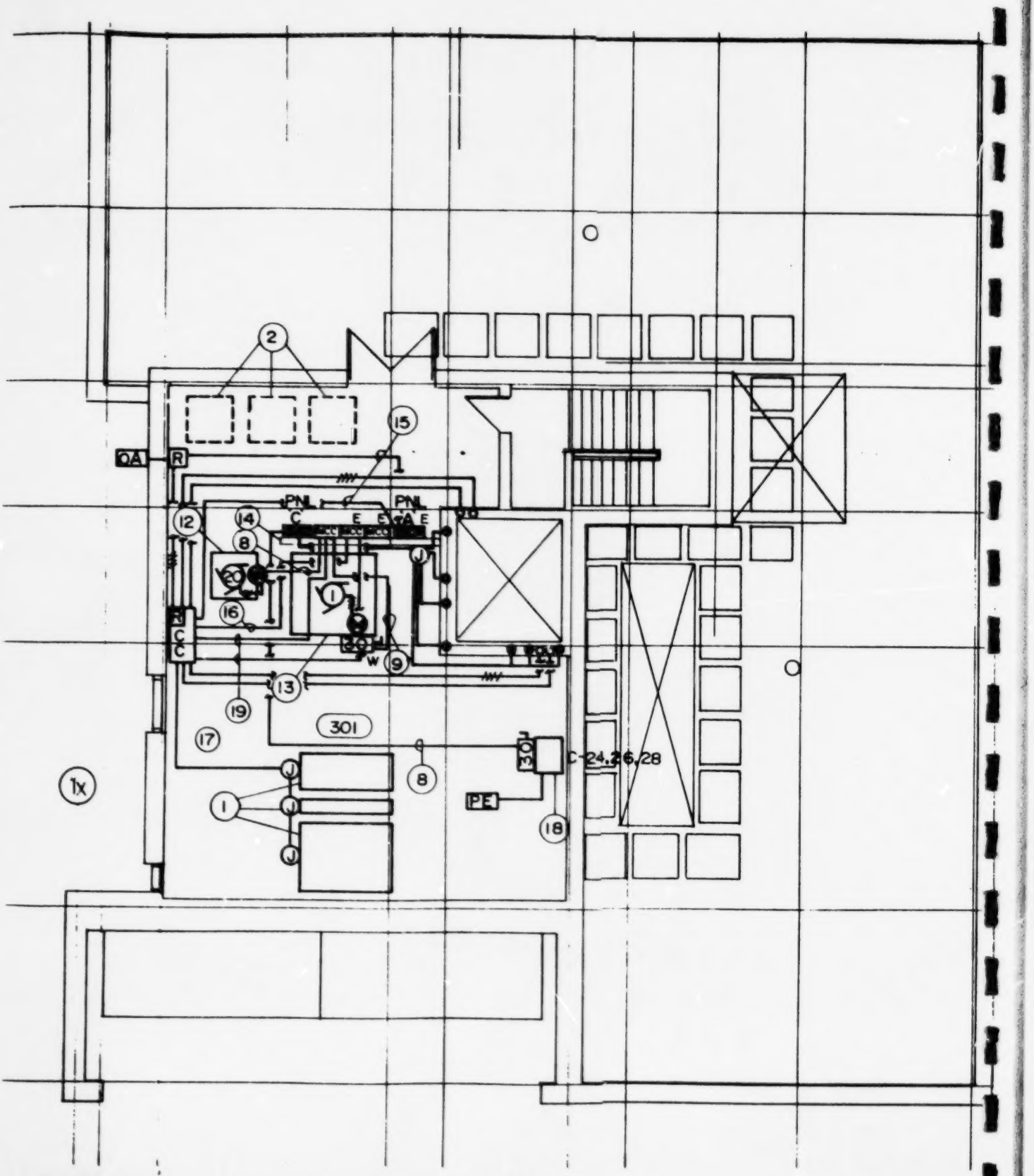
SCALE: 1/8"=1'-0"



MAIN FLOOR PLAN

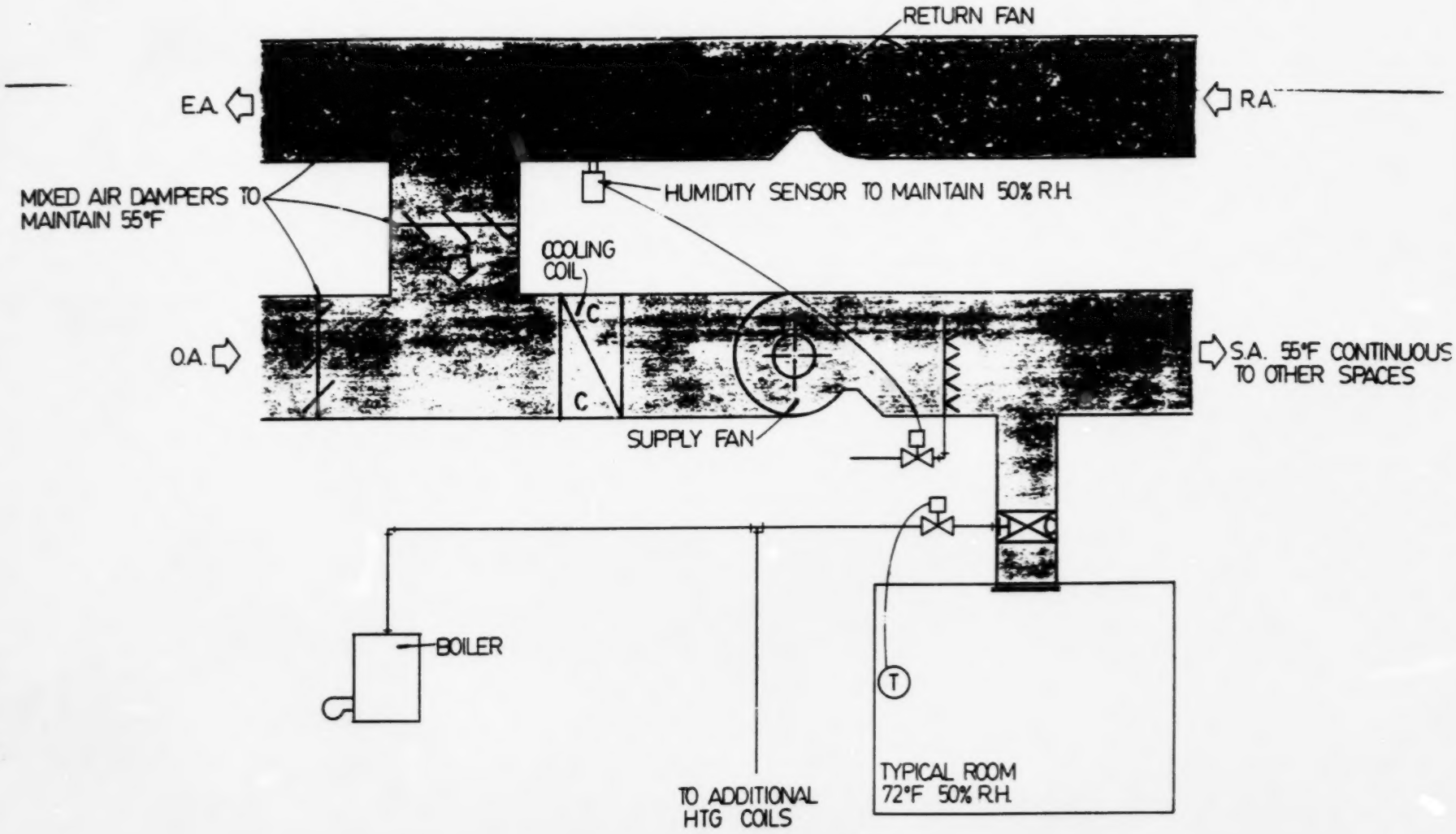


SECOND FLOOR PLAN

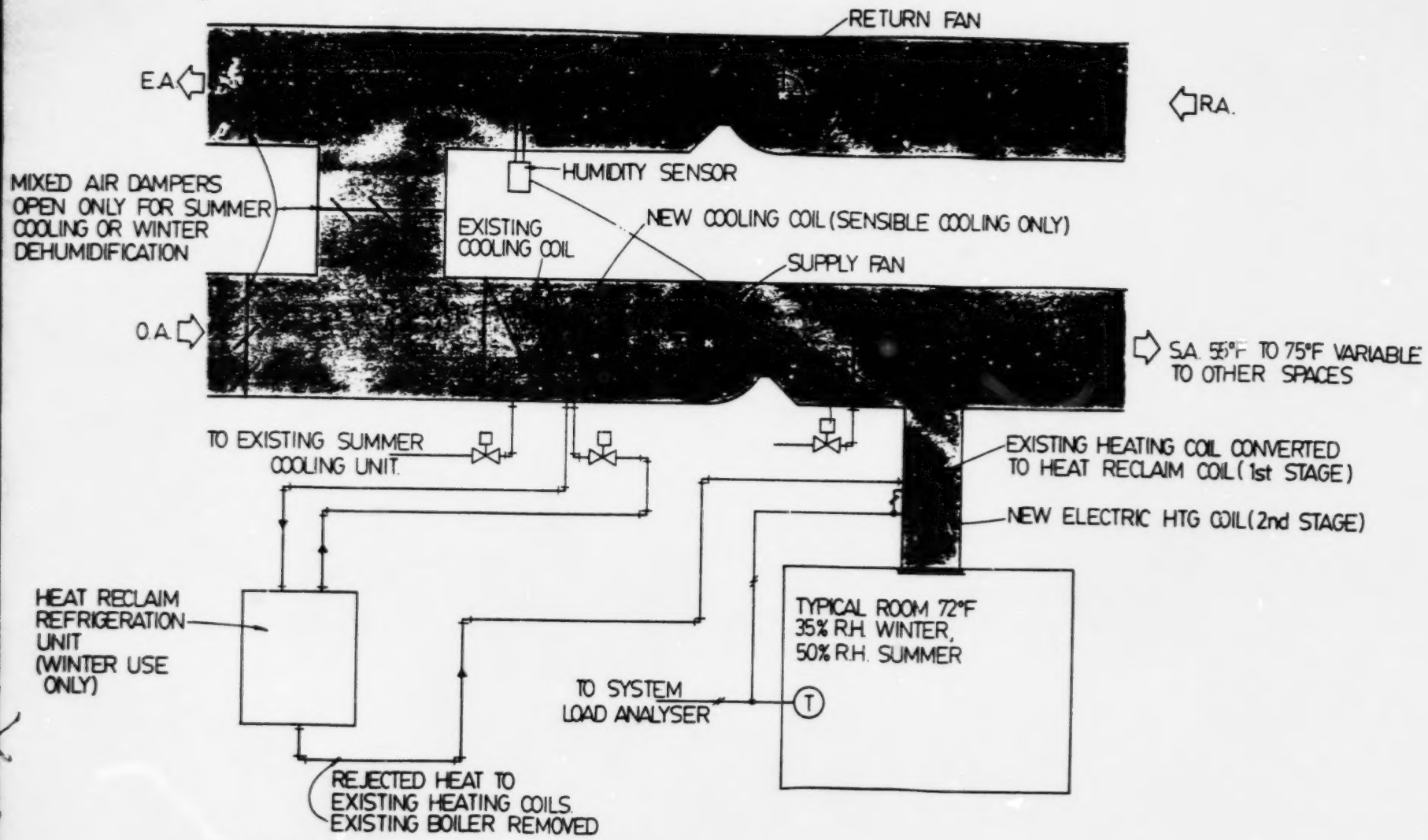


ROOF & PENTHOUSE FLOOR PLAN

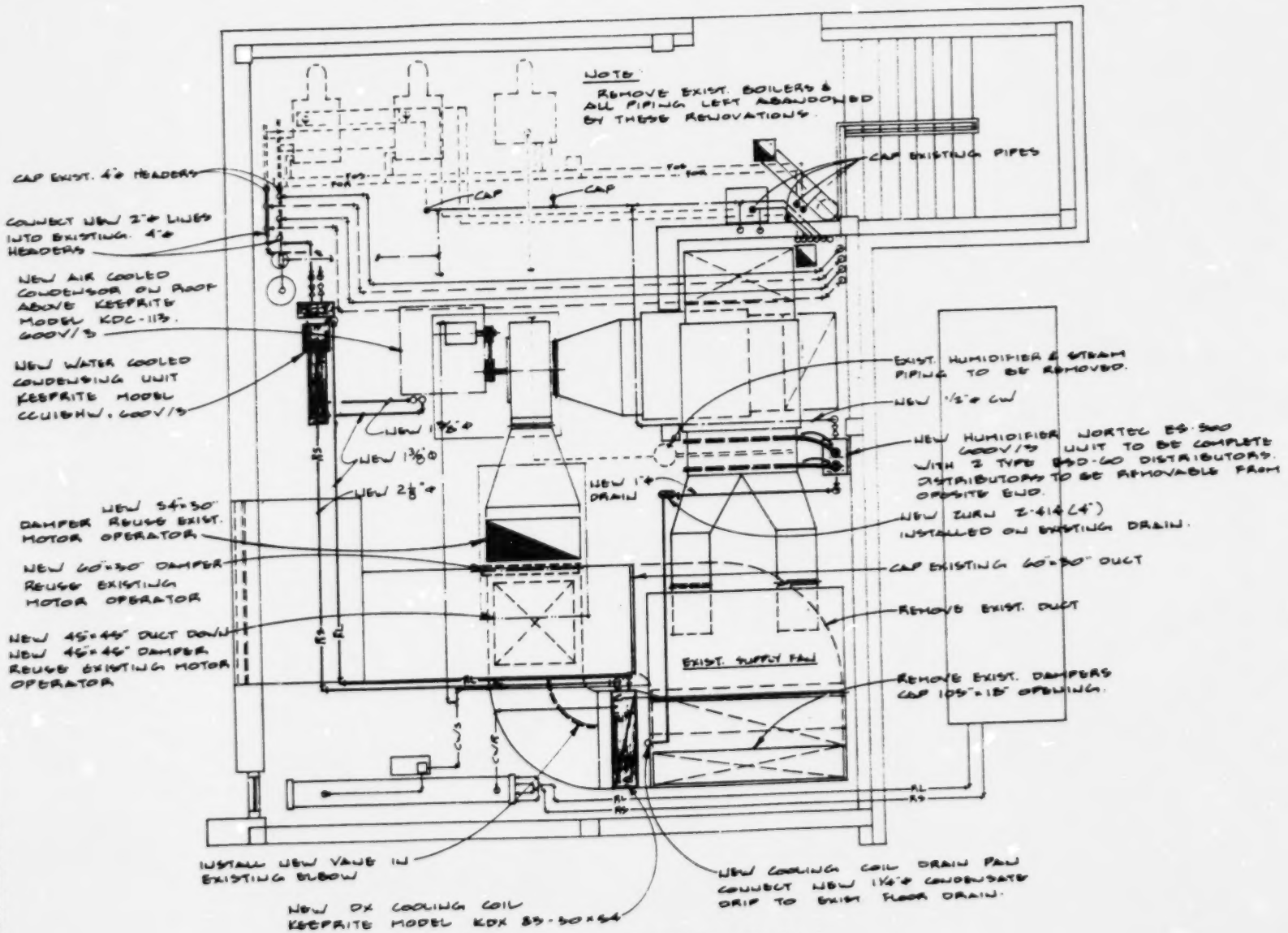
SCALE: 1/8"=1'-0"



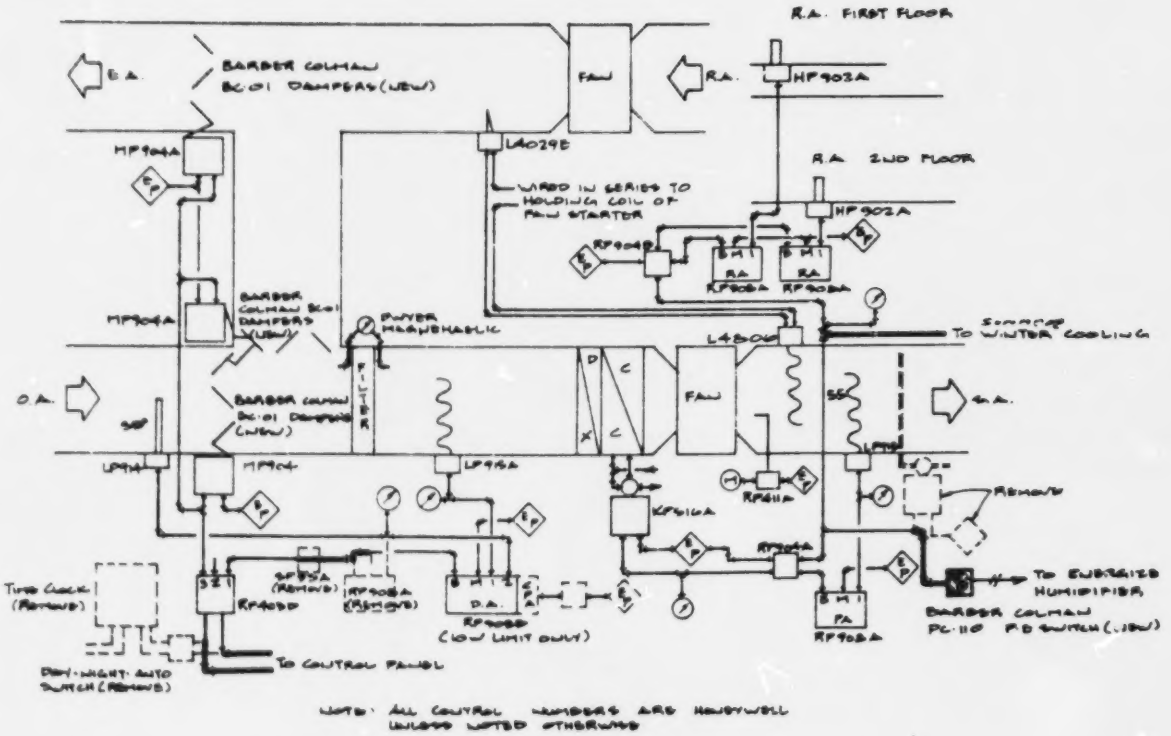
MONCTON MUSEUM BEFORE RETROFIT



MONCTON MUSEUM AFTER RETROFIT


NOTE:
REMOVE EXIST. BOILERS & ALL PIPING LEFT ABANDONED BY THESE RENOVATIONS.
CAP EXIST. 4"ø HEADERS
CONNECT NEW 2"ø LINES INTO EXISTING 4"ø HEADERS
NEW AIR COOLED CONDENSOR ON ROOF ABOVE KEEPRITE MODEL KDC-113. 600V/3
NEW WATER COOLED CONDENSING UNIT KEEPRITE MODEL CCU18HW. 600V/3
CAP EXISTING PIPES
CAP
CAP
EXIST. HUMIDIFIER & STEAM PIPING TO BE REMOVED.
NEW 1/2"ø CW
NEW HUMIDIFIER NORTEC ES-500 600V/3 UNIT TO BE COMPLETE WITH 2 TYPE ESD-60 DISTRIBUTORS. DISTRIBUTORS TO BE REMOVABLE FROM OPPSITE END.
NEW 1 1/2"ø
NEW 1 3/8"ø
NEW 2 1/8"ø
NEW 1"ø DRAIN
NEW TURN Z-414 (4")
INSTALLED ON EXISTING DRAIN.
NEW 54"x30" DAMPER REUSE EXIST. MOTOR OPERATOR
NEW 60"x30" DAMPER REUSE EXISTING MOTOR OPERATOR
CAP EXISTING 60"x30" DUCT
REMOVE EXIST. DUCT
NEW 45"x45" DUCT DOWN
NEW 45"x45" DAMPER REUSE EXISTING MOTOR OPERATOR
EXIST. SUPPLY FAN
REMOVE EXIST. DAMPERS CAP 105"x18" OPENING.
INSTALL NEW VALVE IN EXISTING ELBOW
NEW DX COOLING COIL KEEPRITE MODEL KDX 85-50x54
NEW COOLING COIL DRAIN PAN CONNECT NEW 1 1/2"ø CONDENSATE DRIP TO EXIST FLOOR DRAIN.

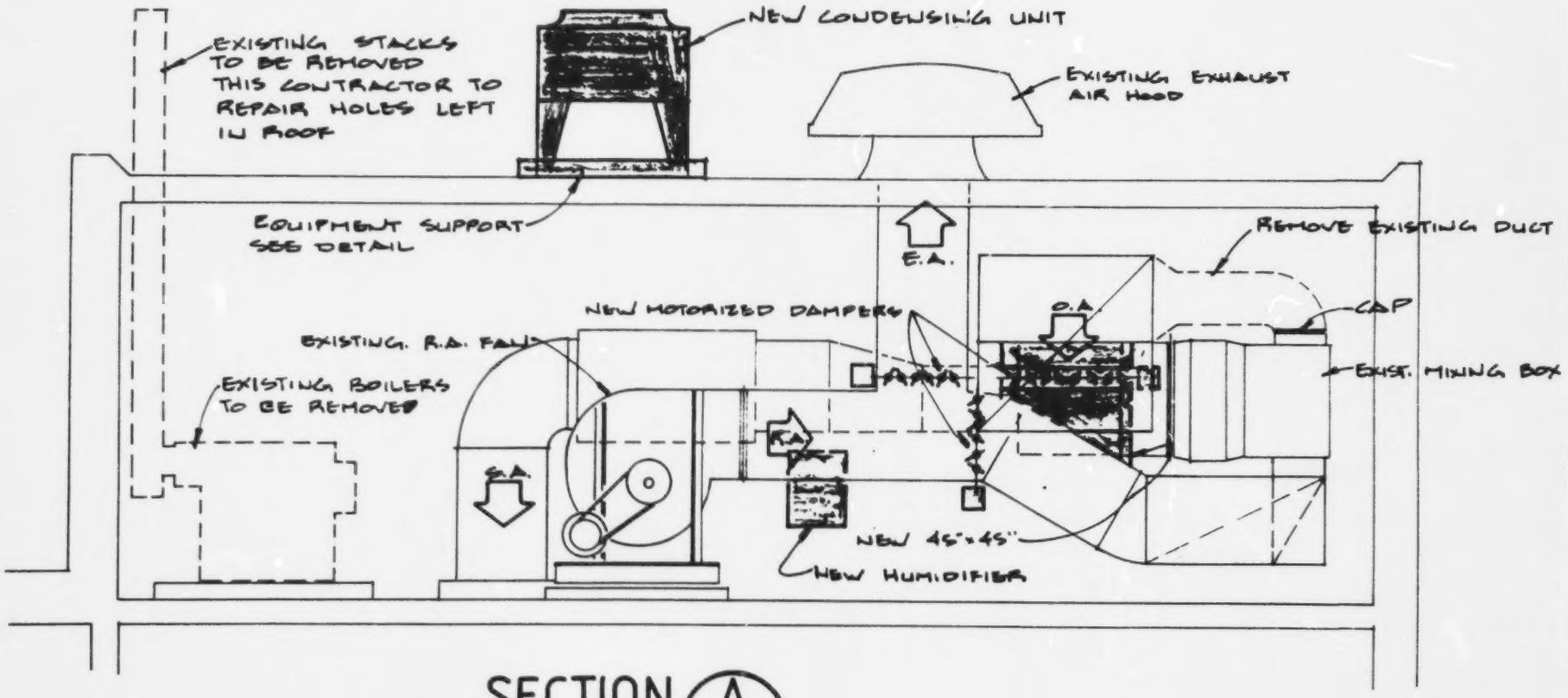
PENTHOUSE FLOOR PLAN



NOTE: ALL CONTROL NUMBERS ARE HONEYWELL UNLESS NOTED OTHERWISE

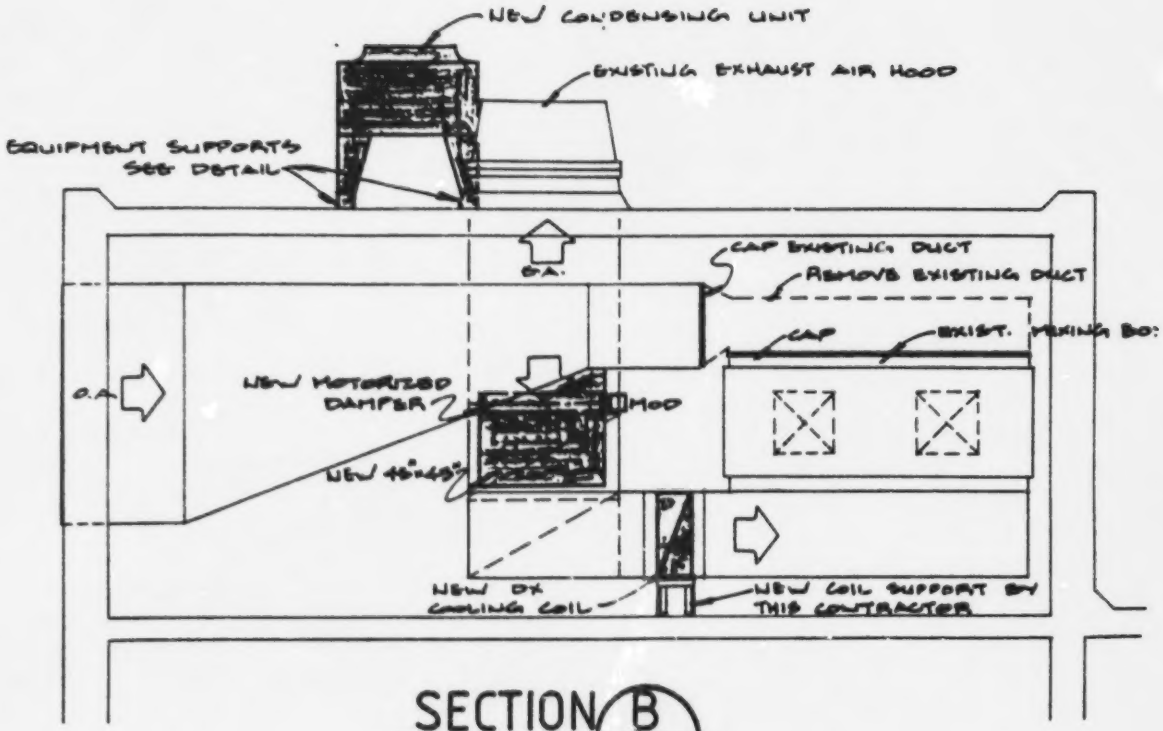
AIR CONDITIONING CONTROL SCHEMATIC

LT4.



SECTION A 2|1

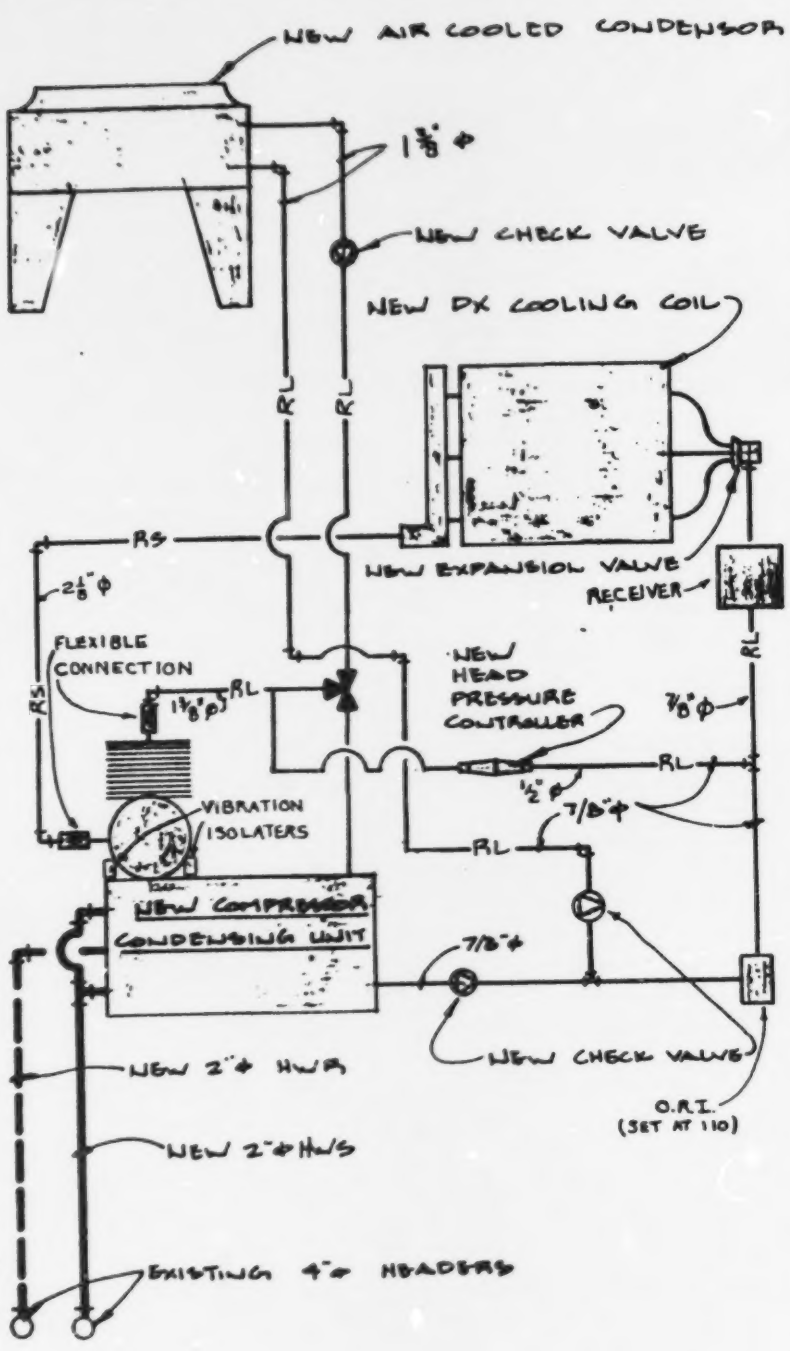
1/4"=1'-0"



SECTION B

1/4"=1'-0"

2|1

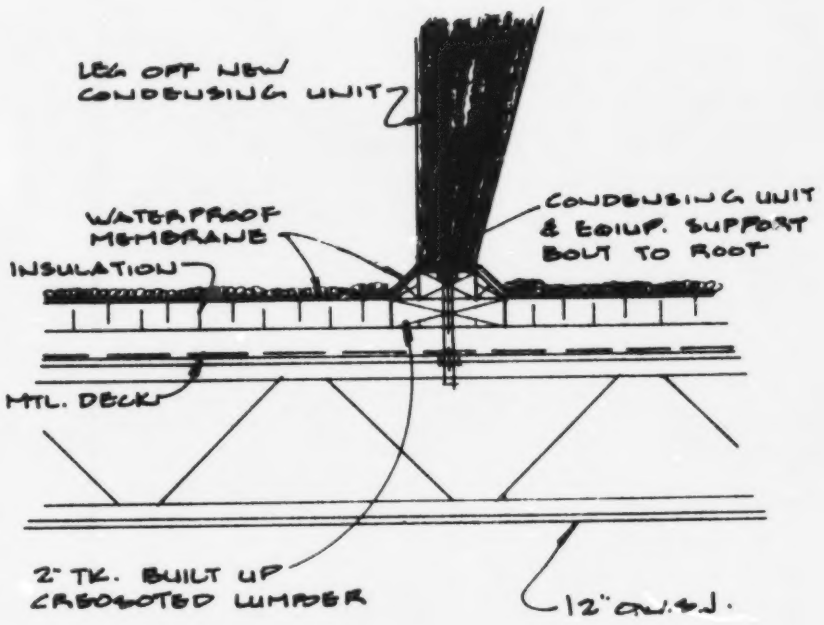


REFRIGERATION PIPING SCHEMATIC

N.T.S.

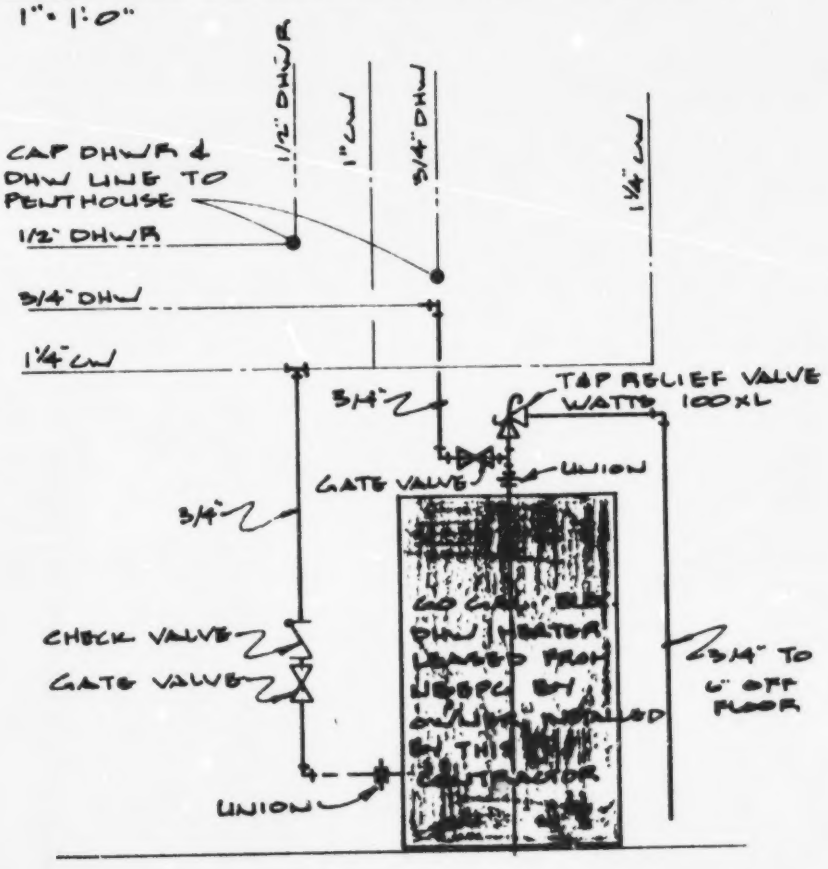
NOTE:

CONTRACTOR TO INSTALL NEW CIRCUIT SETTERS IN DISCHARGE LINES OF EXISTING HEATING CIRCULATING PUMPS.



EQUIPMENT SUPPORT DETAIL

1" = 1'-0"



DHW HTR. INSTALLATION DETAIL

N.T.S.

SYMBOL	LEGEND
	ELECTRICAL DUCT HEATER, SUPPLIED AND INSTALLED BY DIV. 15, WIRED BY DIV. 16.
	JUNCTION BOX.
	HOME RUN, CROSS HATCHES INDICATES NUMBER OF WIRES, NO CROSS HATCHES INDICATES 2 #12 AWG IN 1/2" EMT UNLESS NOTED OTHERWISE.
	CONDUIT UP.
	CONDUIT DOWN.
E	RECESSED ELECTRICAL PANEL, E - EXISTING.
E	SURFACE ELECTRICAL PANEL, E - EXISTING.
1/4	SINGLE PHASE MOTOR BY DIV. 15, 1/4 INDICATES HORSEPOWER, WIRED BY DIV. 16.
20	THREE PHASE MOTOR BY DIV. 15, 20 INDICATES HORSEPOWER, WIRED BY DIV. 16.
	MANUAL MOTOR STARTER BY DIV. 16, RECESSED.
	DIRECT CONNECTED EQUIPMENT.
DHWH	DOMESTIC HOT WATER HEATER BY DIV. 15, WIRED BY DIV. 16.
CC	CONTROL CABINET BY DIV. 15, WIRED BY DIV. 16 SEE WIRING DETAIL ON MECHANICAL DRAWING M2.
H	HUMIDITY TRANSMITTER BY DIV. 15, WIRED BY DIV. 16.
T E	EXISTING ELECTRICAL THERMOSTAT.
T	ROOM TEMPERATURE SENSOR BY DIV. 15, WIRED BY DIV. 16.
1500 W	ELECTRIC BASEBOARD HEATER MOUNTED 3" A.F.F. C/W INTEGRAL THERMOSTAT, 1500- INDICATES WATTAGE.
PE	NEW PNEUMATIC ELECTRIC SWITCH BY DIV. 15, WIRED BY DIV. 16.
AF	NEW AIR FLOW SWITCH BY DIV. 15, WIRED BY DIV. 16.
	FORCE FLOW RECESSED WALL HEATER BY DIV. 16, C/W INTEGRAL THERMOSTAT.
OA	OUTSIDE AIR TEMPERATURE SENSOR AND RELAY BY DIV. 15, WIRED BY DIV. 16.
R M	RELAY BY DIV. 15, WIRED BY DIV. 16, M INDICATES MOUNTED IN EXISTING STARTER.
E	4 PLEX MOTOR CONTROL CENTRE TO MATCH EXISTING WESTINGHOUSE UNITS, E - EXISTING UNITS.
W	DISCONNECT SWITCH, W - WEATHERPROOF.

NOTES

1. REMOVE EXISTING THERMOSTAT AND PATCH AND PAINT HOLE IN WALL.
2. PATCH AND PAINT OPENING IN WALL FOR RECESSED FORCE FLOW HEATER, 4 KW, 600/1/60.
3. TWO EXISTING FUEL PUMPS TO BE ELECTRICALLY DISCONNECTED AND CIRCUIT TERMINATED BY DIV. 16. REMOVE STARTERS.
4. DUCT HEATER C1, 1.3 KW, 600/1/60.
5. DUCT HEATER C2, 1.3 KW, 600/1/60.
6. DUCT HEATER C3, 1.5 KW, 600/1/60.
7. DUCT HEATER C4, 2.5 KW, 600/1/60.
8. DUCT HEATER C5, 3.2 KW, 600/1/60.
9. DUCT HEATER C6, 3.5 KW, 600/1/60.
10. DUCT HEATER C7, 2.4 KW, 600/1/60.
11. DUCT HEATER C9, 6 KW, 600/1/60.
12. DUCT HEATER C10, 7.3 KW, 600/1/60.
13. DUCT HEATER C11, 7 KW, 600/1/60.
14. DUCT HEATER C12, 8.9 KW, 600/1/60.
15. DUCT HEATER C13, 8.6 KW, 600/1/60.
16. DUCT HEATER C15, 13.6 KW, 600/3/60.
17. DUCT HEATER C18, 10 KW, 600/3/60.
18. DOMESTIC HOTWATER HEATER 9 KW, 208/1/60.
19. BLOWER MOTOR 1/ HP, 120/1/60.
20. 2 #10 IN 1/2" EMT.
21. 3 #10 IN 1/2" EMT.
22. 4 #10 IN 1/2" EMT, UP TO PANEL 'C' IN PENTHOUSE.
23. 6 #10 IN 3/4" EMT, UP TO PANEL 'C' IN PENTHOUSE.
24. SUPPLY AND INSTALL NEW 1 - 70A,2P CIRCUIT BREAKER IN EXISTING PANEL B TO FEED HEAT.

NOTES

1. EXISTING DAMPER MOTOR E-P SWITCH ON DUCT TO BE DISCONNECTED BY DIV. 16, REPOSITIONED IN NEW DUCT BY DIV. 15 AND REWIRED AND CONNECTED BY DIV. 16.
2. THREE EXISTING BOILERS TO BE ELECTRICALLY DISCONNECTED AND CIRCUIT TERMINATED BY DIV. 16. REMOVE STARTERS.
3. DUCT HEATER C8, 5.6 KW, 600/1/60.
4. DUCT HEATER C14, 21.6 KW, 600/3/60.
5. DUCT HEATER C16,12.9 KW, 600/3/60.
6. DUCT HEATER C17, 32.2 KW, 600/3/60.
7. 2 #12 IN 1/2" EMT.
8. 3 #10 IN 1/2" EMT.
9. 3 #12 IN 1/2" EMT.
10. 3 #8 IN 3/4" EMT
11. UP TO PANEL 'C' IN PENTHOUSE.
12. NEW WATER COOLED CONDENSING UNIT BY DIV. 15, WIRED BY DIV. 16. 20 HP, 20 FLA, 600/3/60.
13. NEW AIR COOLED CONDENSING UNIT ON ROOF BY DIV. 15, WIRED BY DIV. 16. 1 HP, 1.5 FLA, 600/3/60.
14. EXTEND STEEL FRAME RACK AND PLYWOOD BACKBOARD TO ACCOMODATE MOUNTING OF NEW PANEL C, AND MCC.
15. 120V SUPPLY CIRCUIT TO MECHANICAL CONTROL CABINET OR DEVICES. REUSE EXISTING 20A,1P CIRCUIT BREAKER USED TO FEED ONE OF THREE BOILERS.
16. CONNECT IN SERIES WITH SUPPLY FAN STARTER CONTROL CIRCUIT
17. DIV. 16 TO REMOVE EXISTING MECHANICAL TIME CLOCK IN PENTHOUSE AND TERMINATE CIRCUIT.
18. HUMIDIFIER BY DIV. 15, WIRED BY DIV. 16. 20KW, 19.2 FLA, 600/3/60.
19. RELAY BY DIV. 15 TO BE LOCATED IN STARTER ASSOCIATED WITH MOTOR BY DIV. 16. SEE COOLING UNITS CONTROL SCHEMATIC OF MECHANICAL DRAWING M2.
20. CONNECT BUS OF NEW MCC TO EXISTING 600V MCC BUS WITH 4 #3/0 RW90 WIRE IN WIREWAY.

ELECTRIC DUCT HEATER SCHEDULE

MARK	MANUFACTURER	SIZE	CFM	KW	VOLTS	PH.	HZ.	NOTES
E-1	P.M. WRIGHT ST 66-61-1.3A1	6"Φ	115	1.3	600	1	60	SINGLE STAGE ROUND HTR.
E-2	P.M. WRIGHT ST 66-61-1.3A1	6"Φ	95	1.3	600	1	60	SINGLE STAGE ROUND HTR.
E-3	P.M. WRIGHT ST 66-61-1.5A1	6"Φ	125	1.5	600	1	60	SINGLE STAGE ROUND HTR.
E-4	P.M. WRIGHT ST 106-61-2.5A1	10"x6"	260	2.5	600	1	60	SINGLE STAGE
E-5	P.M. WRIGHT ST 126-61-3.2A1	12"x6"	360	3.2	600	1	60	SINGLE STAGE
E-6	P.M. WRIGHT ST 107-61-3.5A1	10"x7"	320	3.5	600	1	60	SINGLE STAGE
E-7	P.M. WRIGHT ST 106-61-2.4A1	10"x6"	260	2.4	600	1	60	SINGLE STAGE
E-8	P.M. WRIGHT ST 85-61-5.6A2	8"x5"	350	5.6	600	1	60	TWO STAGE
E-9	P.M. WRIGHT ST 108-61-6A2	10"x8"	400	6.0	600	1	60	TWO STAGE
E-10	P.M. WRIGHT ST 148-61-6A2	14"x8"	580	7.3	600	1	60	TWO STAGE
E-11	P.M. WRIGHT ST 188-61-7A2	18"x8"	720	7.0	600	1	60	TWO STAGE
E-12	P.M. WRIGHT ST 168-61-8.9A2	16"x8"	690	8.9	600	1	60	TWO STAGE
E-13	P.M. WRIGHT ST 218-61-8.6A2	21"x8"	975	8.6	600	1	60	TWO STAGE
E-14	P.M. WRIGHT ST 288-63-21.6P2	28"x8"	1600	21.6	600	3	60	TWO STAGE
E-15	P.M. WRIGHT ST 308-63-13.6P2	30"x8"	1420	13.6	600	3	60	TWO STAGE
E-16	P.M. WRIGHT ST 188-63-12.9 P2	18"x8"	1000	12.9	600	3	60	TWO STAGE
E-17	P.M. WRIGHT ST 2814-63-32.2 P2	28"x14"	3160	32.2	600	3	60	TWO STAGE
E-18	P.M. WRIGHT ST 326-63-10A1	32"x6"	300	10.0	600	3	60	SINGLE STAGE

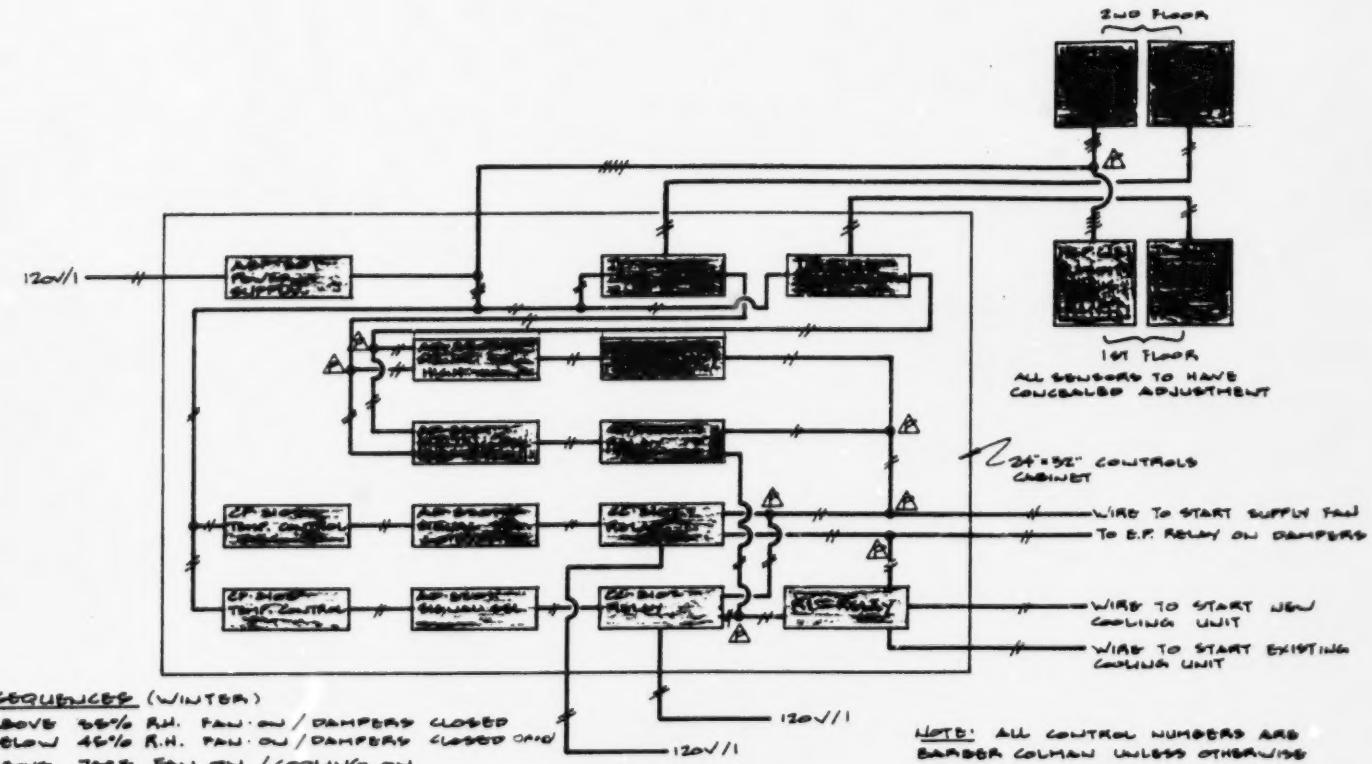
NEW PANEL C

POWER SUPPLY: 347/600V,3Ø,4W

MAINS: 225A

BRANCH BREAKERS:

DESCRIPTION	LOAD A	LOAD B	LOAD C					LOAD A	LOAD B	LOAD C	DESCRIPTION
DUCT HEATERS BASEMENT	6450			30	1		2				DUCT HEATER 2nd FLOOR
C2,C4,C5,C6,C7		6450			3		4	15	2800		C8, 5.6 KW
DUCT HEATERS BASEMENT			5650	30	5		6			7200	DUCT HEATER, 2nd FLOOR
C1,C3,C11 RM. 009, BB	5650				7		8	30	7200		C14, 21.6 KW
DUCT HEATERS MAIN FLOOR		7866			9		10			7200	
C18 10 KW			7866	30	11		12			4300	DUCT HEATER 2nd FLOOR
C15 13.6 KW	7866				13		14	20	4300		C16, 12.9 KW
DUCT HEATERS & FF MAIN FL.		6450		30	15		16			4300	
C12 & FF.			6450		17		18			10733	DUCT HEATER 2nd FLOOR
DUCT HEATERS MAIN FLOOR	6650			30	19		20	40	10733		C17, 32.2 KW
C9, C10		6650			21		22			10733	
DUCT HEATERS, & BB. MAIN FL			5550	30	23		24			6666	HUMIDIFIER
C13, BB. RM.103A,103B	5550				25		26	30	6666		20 KW
					27		28			6667	
					29		30				
					31		32				
					33		34				
					35		36				
					37		38				
					39		40				
					41		42				
PHASE LOAD	32162	27416	25516						1701	28800	PHASE LOAD
TOTAL LOAD 177398											



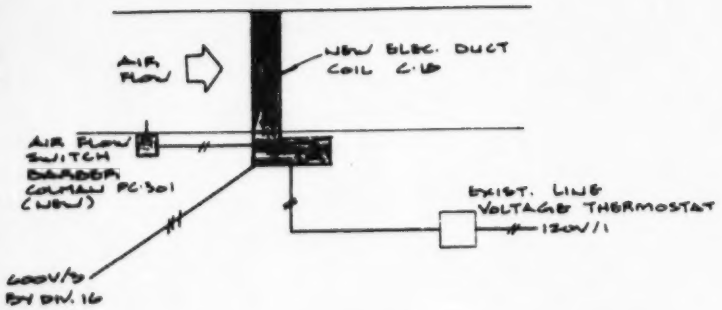
SEQUENCES (WINTER)

ABOVE 55% R.H. FAN ON / DAMPERS CLOSED
BELOW 45% R.H. FAN ON / DAMPERS CLOSED
ABOVE 75°F FAN ON / COOLING ON
BELOW 70°F FAN ON

NOTE: ALL CONTROL NUMBERS ARE BARBER COLMAN UNLESS OTHERWISE NOTED.

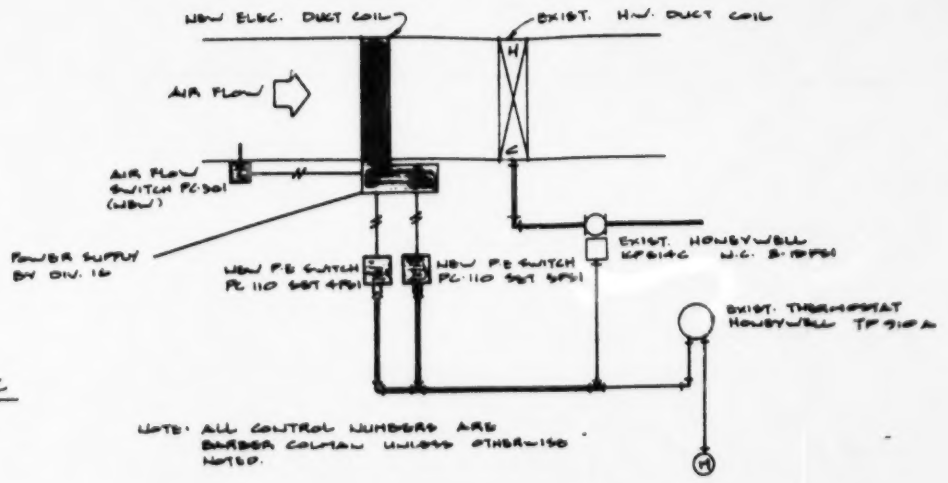
NEW CONTROL PANEL WIRING SCHEMATIC

U.T.S.



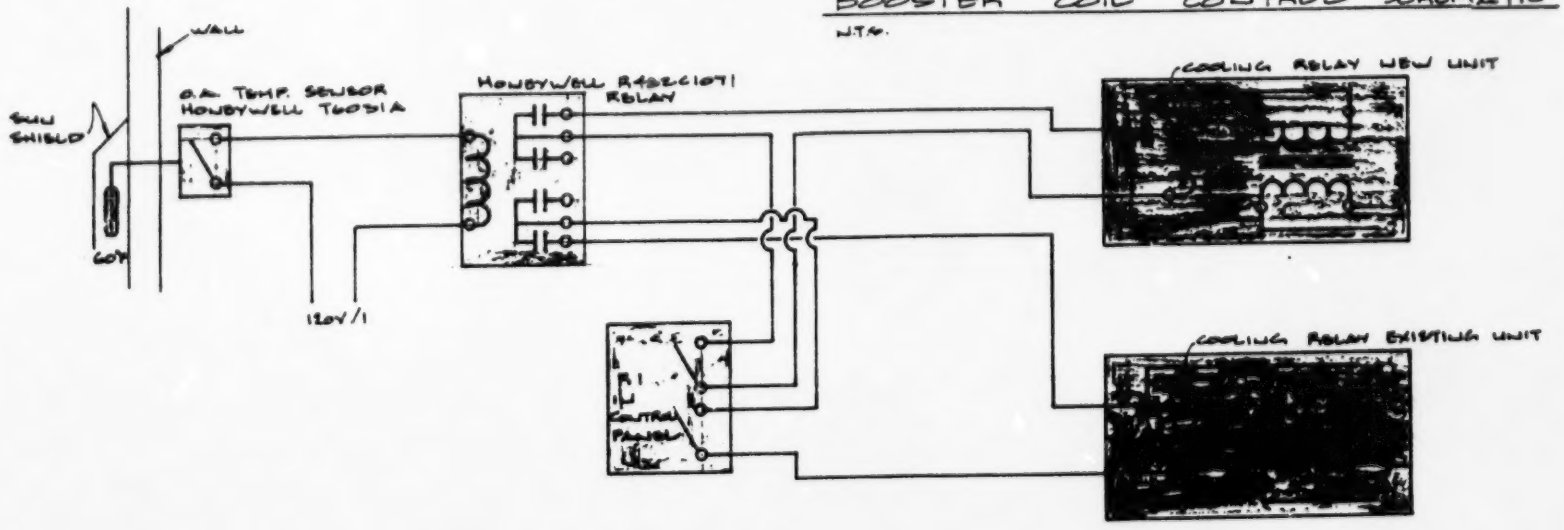
BOOSTER COIL C-18 CONTROL SCHEMATIC

N.T.S.


NEW ELEC. DUCT COIL
EXIST. H.V. DUCT COIL
AIR FLOW
AIR FLOW SWITCH PC-301 (NEW)
POWER SUPPLY BY DIV. 16
NEW PE SWITCH PC-110 SET 4PSI
NEW PE SWITCH PC-110 SET 5PSI
EXIST. HONEYWELL
EXIST. THERMOSTAT HONEYWELL TP-910A
NOTE: ALL CONTROL NUMBERS ARE BARBER COLMAN UNLESS OTHERWISE NOTED.

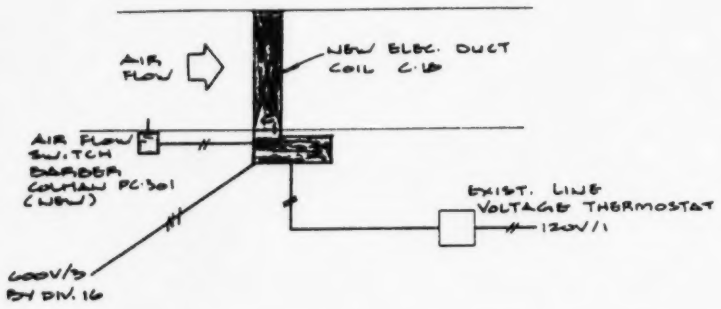
BOOSTER COIL CONTROL SCHEMATIC

N.T.S.



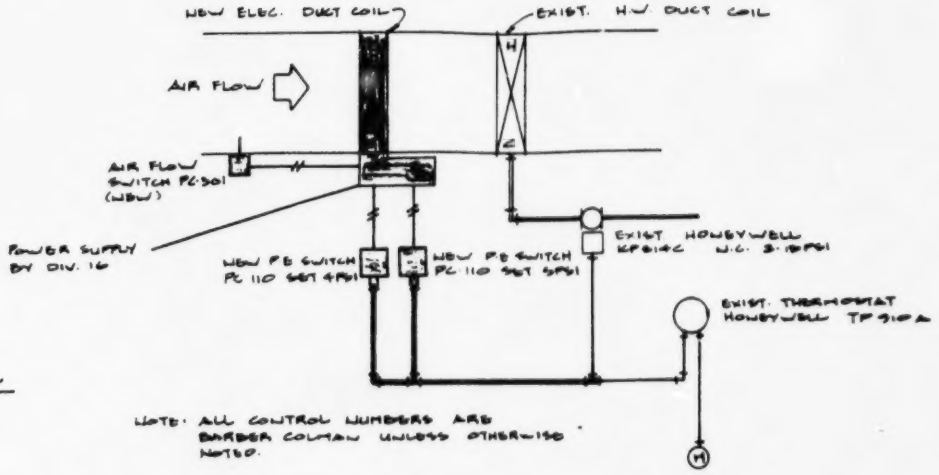
COOLING UNITS CONTROL SCHEMATIC

N.T.S.



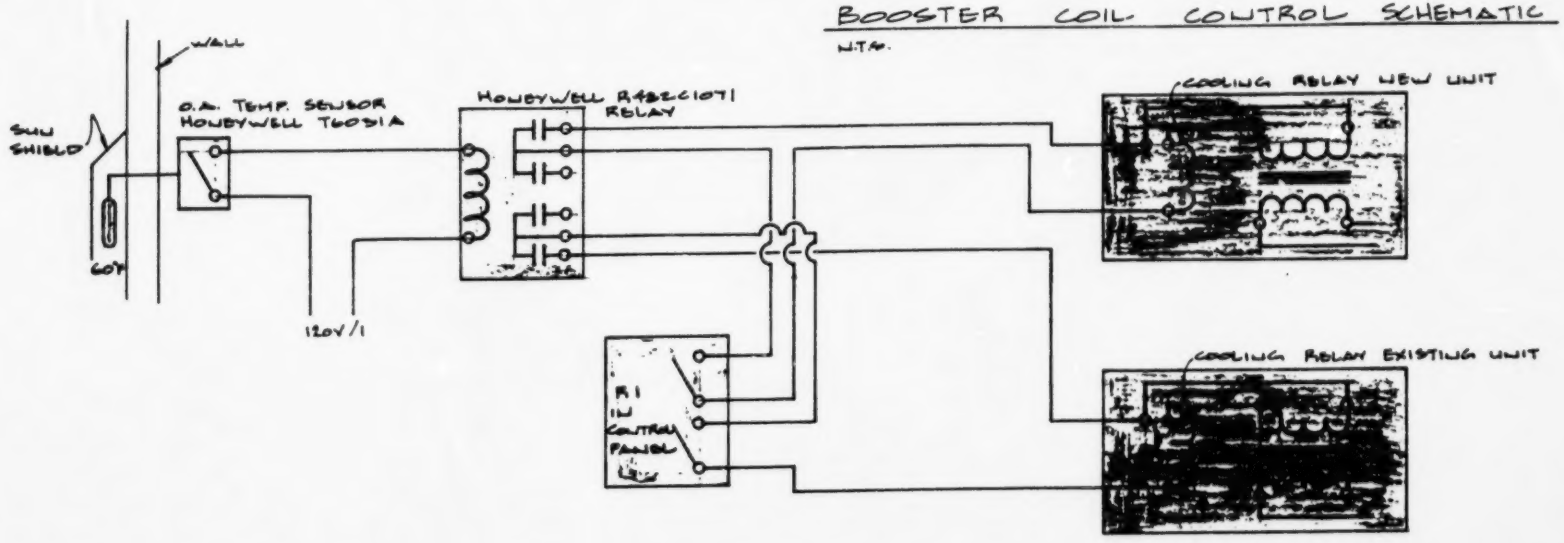
BOOSTER COIL C-18 CONTROL SCHEMATIC

N.T.S.


NEW ELEC. DUCT COIL
EXIST. H.V. DUCT COIL
AIR FLOW
AIR FLOW SWITCH PC-301 (NEW)
POWER SUPPLY BY DIV. 16
NEW PE SWITCH PC 110 SET 4PSI
NEW PE SWITCH PC 110 SET 5PSI
EXIST. HONEYWELL
EXIST. THERMOSTAT HONEYWELL TP 910 A
NOTE: ALL CONTROL NUMBERS ARE BARBER COLMAN UNLESS OTHERWISE NOTED.

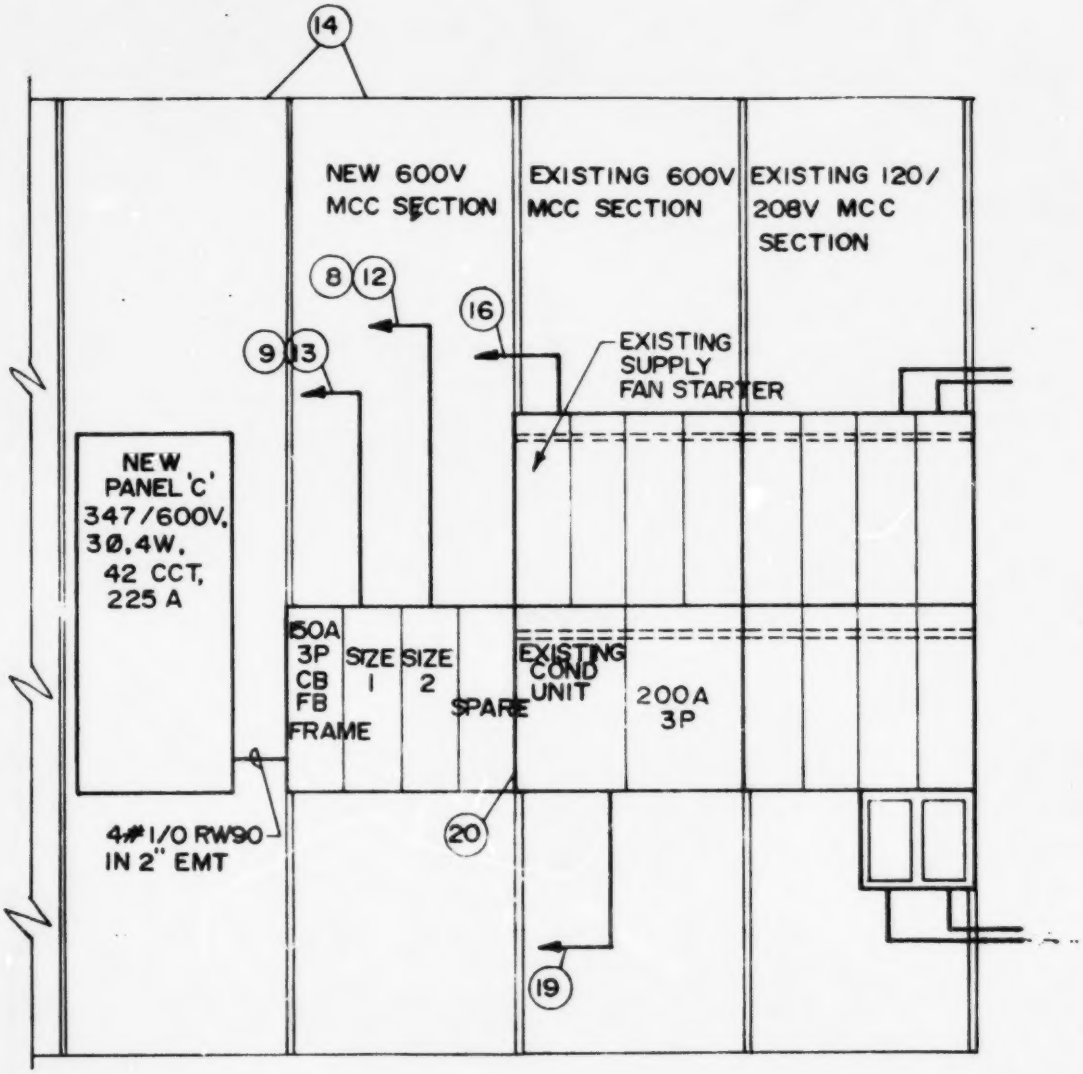
BOOSTER COIL CONTROL SCHEMATIC

N.T.S.



COOLING UNITS CONTROL SCHEMATIC

N.T.S.



PENTHOUSE MOTOR CONTROL & DISTRIBUTION

N.T.S.

Produits Nationaux pour l'Environnement Ltée
National Environmental Products Ltd
8465 9 Devonshire, Montréal Québec H4P 2L1 Tel 735-0871 Telex 05-25576

Vapac

OCT 7 1983

DATE : OCTOBER 5, 1983.

REFERENCE :

LOCATION :

CONTRACTOR : KEY MECHANICAL

ENGINEER :

SUBMITTED BY : GERALD FORSYTHE, MONCTON, N.B.

DATE ORDERED : 09/27/83 DATE REQUIRED :

MODEL : V40L-6 QUANTITY : 1

SYSTEM NUMBER :

UNIT CAPACITY IN KG./HR. : 40 MAX. 8 MIN.

UNIT CAPACITY IN LB./HR. : ~~88~~ 60 MAX. 17.6 MIN.

VOLTAGE : 600/3/60 KW : 30

UNIT RUNNING AMPS : ~~77~~ APPROX. 20 MAX. 6.4 MIN.

CONTROL VOLTAGE : 24 BREAKER SIZE : 40

MANIFOLD(S) : 2 LENGTH : 48"

STEAM HOSE(S) : 2 LENGTH : 10' TOTAL

TYPE OF CONTROL : ON/OFF X

STEP

MODULATING

ACCESSORIES : 1 - H49A1019 HONEYWELL DUCT HUMIDISTAT NOT REQUIRED

1 - H402A1023 HONEYWELL HIGH LIMIT HUMIDISTAT

1 - P32AF-2 JOHNSON PRESSURE DIFFERENTIAL SWITCH

1 - RESISTOR FOR P.C. BOARD TO REDUCE CAPACITY TO 60 lb/HR

MANUFACTURERS OF SK AND VAPAC STEAM HUMIDIFIERS
LES FABRICANTS DES HUMIDIFICATEURS À VAPEUR SK ET VAPAC

Vapac Installation, Dimensions and Positioning

Positioning the Vapac

Correct positioning of the unit and correct installation of the steam distribution pipe, steam hose and steam manifold are essential for a trouble-free Vapac installation. The standard Vapac installation arrangements are illustrated in the diagrams.

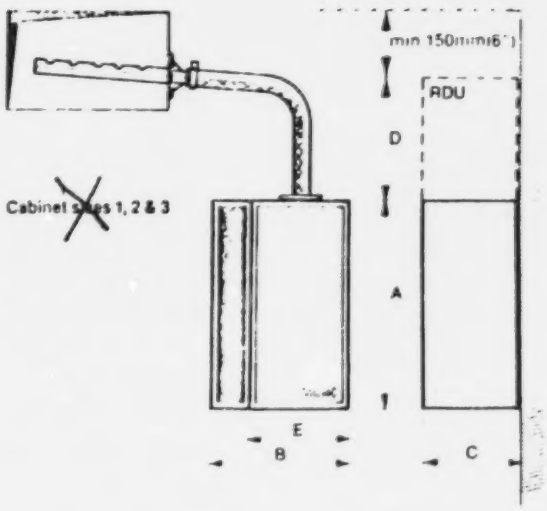
For ease of servicing the Vapac unit must be installed so that the cabinet is accessible from the front and left-hand side. Depending upon the model, the base of the unit should be between 1000mm (3'4") and 1200mm (4'0") above floor level.

In all cases the following basic requirements must be observed.

(1) Allow not less than 700mm (2'3") in front of the cabinet for normal servicing access and cylinder exchange.

(2) Access to the electrical compartment is by removing an access panel on the left-hand side of the cabinet, a clearance of 600mm (2'0") minimum is therefore recommended on this side.

(3) Other equipment/services can be positioned around the Vapac provided that there is always 200mm (8") minimum clearance below the cabinet for the water, drain and electrical connections.



Wall Mounting

A mounting bracket is provided with each cabinet. The bracket when in position will be off set from the centre-line of the cabinet. The bracket should be mounted on a smooth surface using the fixings provided. The Vapac cabinet is then hung on the mounting bracket and secured to it by tightening the captive screw located inside the cabinet.

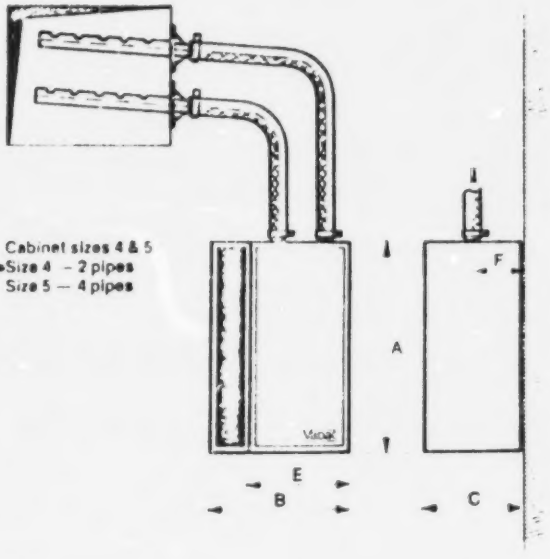
Vapac with RDU (Room Distribution Unit)

The RDU is designed to be mounted directly on top of the Vapac unit. To install a Vapac unit with RDU, the RDU should first be mounted on the Vapac cabinet. The combined Vapac plus RDU can then be offered up to the Vapac mounting bracket.

The bracket position, in this instance, should be based upon the following criteria: –

(a) RDU steam pipe to be above head height – a height of 2m (6'6") to the top of the Vapac cabinet is normally sufficient.

(b) The minimum distance of 150mm (6") between the top of the RDU and a ceiling must be observed to avoid condensation on the ceiling.



Size	Vapac unit codes	No. of pipes
1	V 4	1
2	V 8	1
3	V 15	1
④	V 25 & V 40	2
5	V 50 & V 60	4

Dimensions in mm (ins approx.)

Ref	Vapac cabinet size 1	2	3	④	5
A	500 (20")	630 (24")	675 (27")	800 (31½")	800 (31½")
B	355 (14")	355 (14")	420 (16½")	520 (20½")	640 (25")
C	280 (10")	280 (10")	295 (12")	380 (15")	500 (20")
D	300 (12")	300 (12")	375 (15")	–	–
E	240 (9½")	240 (9½")	285 (11¼")	380 (15")	500 (20")
F	150 (6")	150 (6")	160 (6¼")	190 (7½")	250 (10")
G	100 (4")	100 (4")	127 (5")	125 (5")	105 (4")
H	–	–	–	130 (5")	130 (5")
J	100 (4")	–	–	–	80 (3")
Service weight in kg (lb)					
Unit	16 (35)	20 (44)	24 (53)	50 (110)	85 (187)
RDU	8 (18)	8 (18)	15 (33)	–	–

Plumbing Connections

Vapac Steam Humidifiers are electrode boilers which operate at atmospheric pressure and are designed for connection to standard water supplies — provided local regulations covering this type of equipment are observed. All units in the range are fitted with an air break water feed, which provides a 25mm (1") vertical gap over the maximum overflow level of the fill cup and below the end of the feed pipe so the possibility of contamination of water supply does not exist. Subject to local regulations, this should eliminate the need for a static tank in the supply water feed to the unit. It is recommended that a strainer and a stop-valve be fitted in the water supply system and be positioned adjacent to the unit. Pre-treatment of water fed to Vapac units is unnecessary. The units are designed to operate on a wide range of water quality covering most piped water supplies. Where a salt exchange plant is in use at site, the feed water to the Vapac should bypass this. It is possible to operate a Vapac Series III humidifier on a fully demineralised water supply, but in this case the unit must be selected from the L range and be supplied with the supplementary dosing unit fitted, together with the provision of the dosing circuit on the Vapac 24v control board.

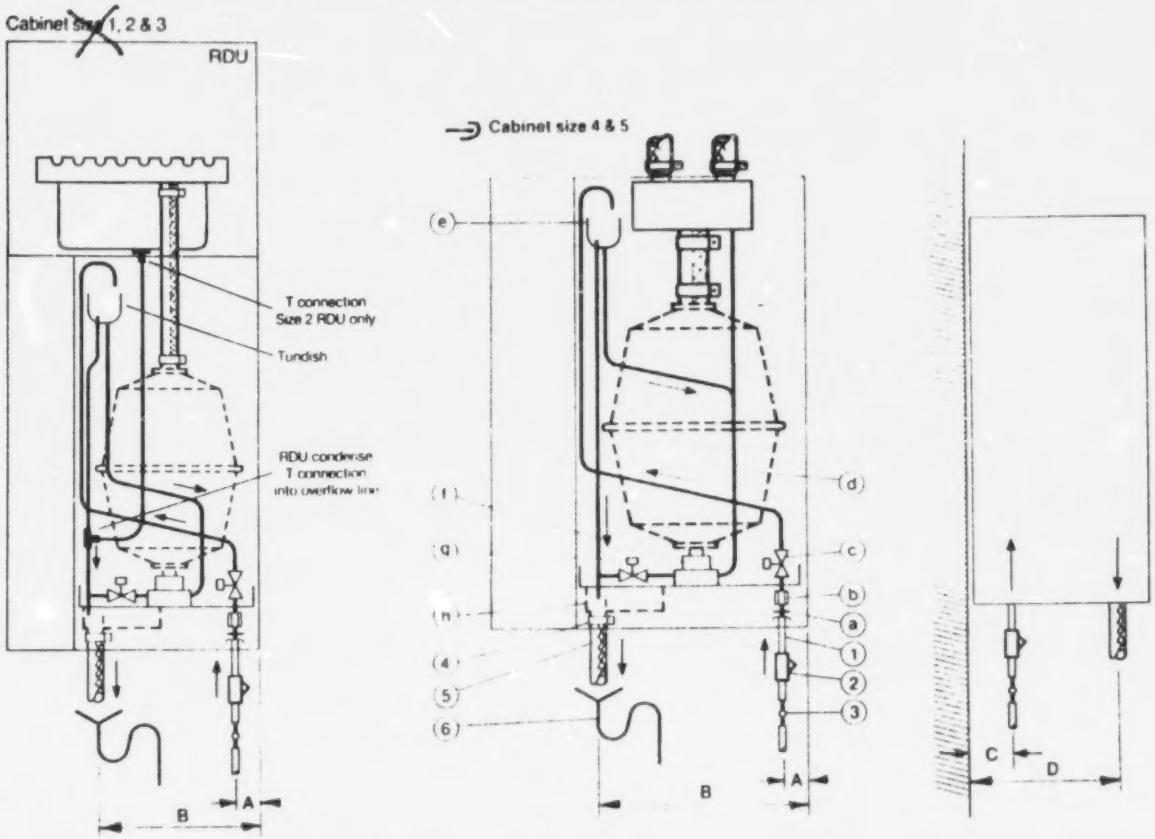
Water Fill-Cup or Tundish
The water supply pipe is positioned directly over the water feed outlet from the water fill-cup so that water falls into the supply hose without splashing. Any misalignment following shipment should be adjusted at installation. The flexible connecting hose taking the water from the tundish to the feed/drain manifold, must follow a smooth curve to avoid air locks, which would cause water to flood the tundish and overflow down the overflow connection.

Water Connection
The Vapac is supplied with fittings for connection to 12mm (½") copper water supply pipe. The nut and compression ring are supplied loose inside the cabinet attached to internal pipework.

Pressure Range
0.3-7.8 bar (a built-in flow regulator compensates for pressure fluctuations).

Drain Connection
The outlet for drain connection is a 35mm (1⅜") diameter spigot. Standard Vapac steam hose and hose clip can be used to provide the connection between Vapac unit and the piped drainage system. Where plastic drain piping is used the temperature rating is 100°C.

General Arrangement and Positions of Vapac Feed and Drain Connections



Internal
- (a) Strainer disc
- (b) Flow regulator
- (c) Feed valve
- (d) Steam cylinder
- (e) Tundish
- (f) Feed/drain manifold
- (g) Drain valve
- (h) Drain trap

External
- (1) Water supply line
- (2) Strainer
- (3) Stop valve
- (4) Hose clip
- (5) Steam hose
- (6) Drain line with tundish & 'U' trap

Dimensions in mm (ins approx.)

Ref.	Vapac Cabinet Size 1	2	3	4	5
A	47 (2")	47 (2")	47 (2")	47 (2")	47 (2")
B	180 (7")	180 (7")	225 (9")	318 (12⅛")	440 (17¼")
C	73 (3")	73 (3")	73 (3")	73 (3")	73 (3")
D	192 (7⅛")	192 (7⅛")	230 (9")	310 (12¼")	430 (17")

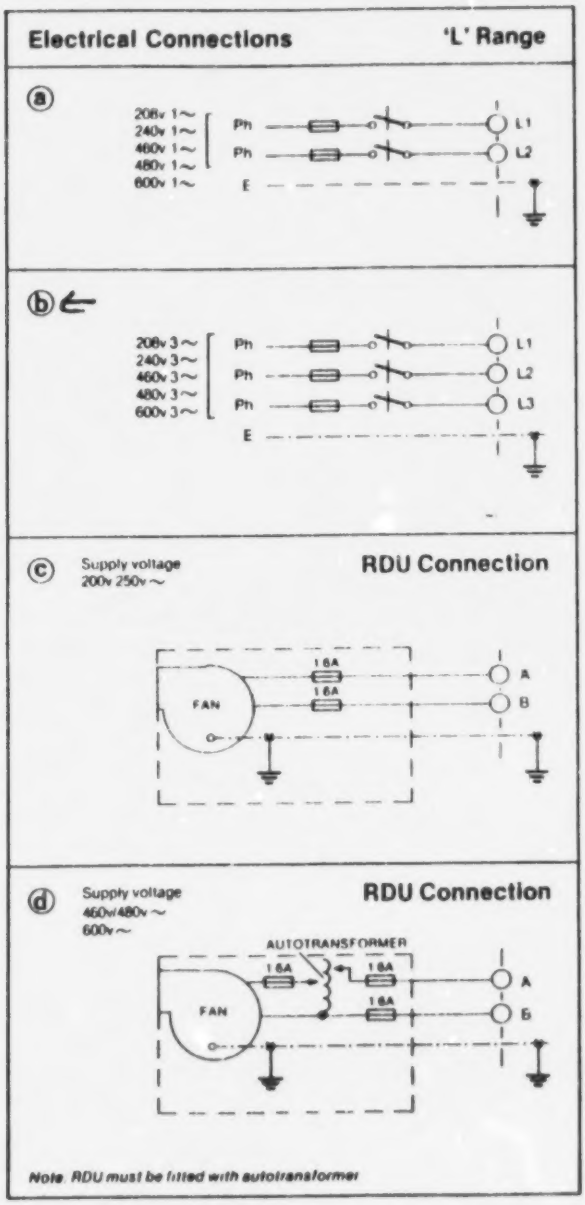
Power Supply Connections

Electrical Connections
External fusing and electrical protection should comply with the appropriate Local Regulations and Codes of Practice. A disconnect/circuit breaker should always be used on the power supply to the Vapac. For convenience of servicing, this should be located adjacent to the Vapac cabinet or, within easy reach and readily accessible.

Appropriately sized cable entry glands should be used in the knockouts provided (on the underside of the electrical compartment) to ensure the cables are securely held at the entry position. The terminals for the power supply connection are sized to suit the normal maximum line current of the unit at the voltage for which it is designed. Terminal connections *must* be secure.

Important: In all cases, external power fuses of size appropriate to the total line current of the unit must be provided by the installing contractor.

Vapac 'L' Range
The internal control circuit of 'L' Range units is operated at 24 volts, which is provided by a Vapac mains transformer.



Control Circuit Connections 'L' Range

The Vapac Series III range has a new, patented technique for capacity control of an electrode boiler humidifier. Previous approaches to the question of output control of an electrode boiler humidifier have involved the alternative disadvantages of either:

(a) energy loss on reducing demand by draining out hot water to give a true response to the control signal.
or
(b) failing to drain water out on reducing demand, yet wasting energy by continuing to operate the humidifier at higher output than the controls demand.

The Vapac Series III offers the possibility of instantaneous output adjustments up and down according to a control signal while maintaining a constant water level in the steam cylinder. This capacity modulation is only practical with units having more than two electrodes.

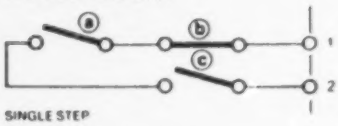
Output control options for Vapac Series III humidifiers.
'L' range without Proportional Adaptor

2 electrode unit — on/off
3 electrode unit — on/off or 2-steps
6 electrode unit — on/off or up to 4-steps of control
12 electrode unit — on/off or up to 4-steps of control

'L' ranges with Proportional Adaptor fitted:

Standard commercial proportional control systems can be used with 'L' units when the Vapac Proportional Adaptor is fitted. The output signal of the controller is then converted by the Vapac adaptor into the maximum switching option for the particular unit as indicated above.

2 electrode unit

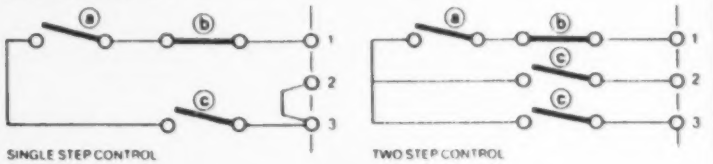


SINGLE STEP

(a) (b) & (c) not of Vapac supply
(a) Fan motor interlock or airflow switch
(b) High humidity override hygrostat (optional)
(c) Control switching by hygrostat or multi-step RH controller

Note: Terminal C (if fitted) is not required for any of the control connections shown on this page

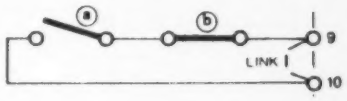
3 electrode unit



SINGLE STEP CONTROL

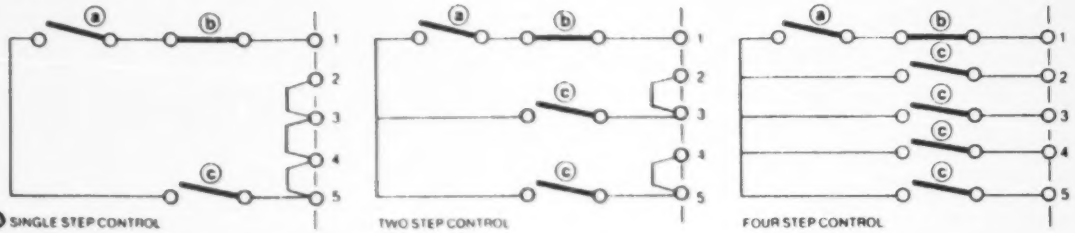
TWO STEP CONTROL

Security Circuit: (not of Vapac supply) — alternative connection to Vapac terminals 9 & 10 (if fitted).



If high-humidity override, airflow switch or fan motor interlock are used, these can be connected between Vapac terminals 9 & 10 (having first removed the link).

6 & 12 electrode unit

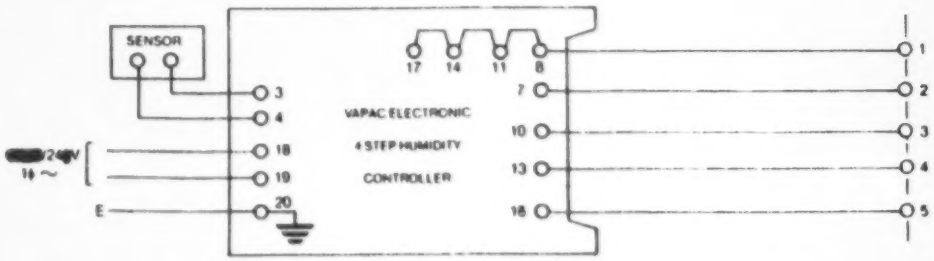


SINGLE STEP CONTROL

TWO STEP CONTROL

FOUR STEP CONTROL

Vapac 4-step Electronic Humidity Controller



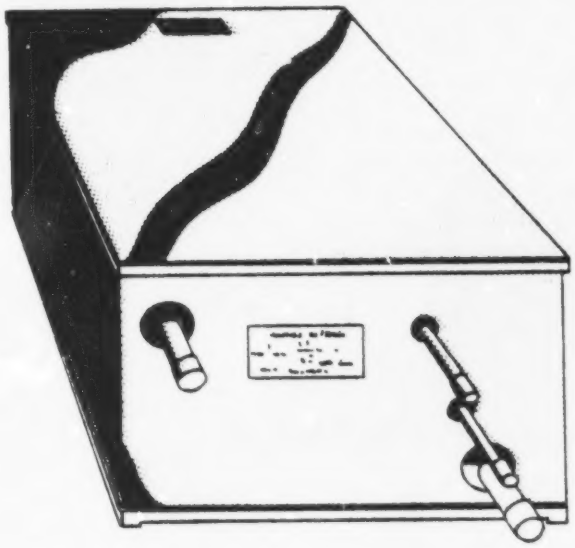
KeepRite

MADE IN CANADA

EnerFlo

HEAT RECOVERY SYSTEMS

* PROVIDES FREE HOT WATER FOR DOMESTIC, COMMERCIAL, OR INDUSTRIAL USE.
* REDUCES REFRIGERATION/AIR CONDITIONING SYSTEM OPERATING COSTS.
* STANDARD MODELS AVAILABLE UP TO 110 TONS USING REFRIGERANTS R22, R12, OR R502.
* NORMAL PAYBACK PERIOD - 12 TO 48 MONTHS.



TYPICAL APPLICATIONS

* RESIDENTIAL
* INSTITUTIONAL
  - HOSPITALS
  - NURSING HOMES
  - UNIVERSITIES/COLLEGES
* RECREATIONAL
  - ARENAS
  - CURLING CLUBS
  - SQUASH/RACQUETBALL FACILITIES
  - SPORTS FACILITIES
* COMMERCIAL
  - MANUFACTURING PLANTS
  - COMMERCIAL BUILDINGS
  - HOTELS/MOTELS
  - RESTAURANTS
* INDUSTRIAL
  - FOOD PROCESSING PLANTS
  - MEAT PROCESSING PLANTS
  - BOTTLING PLANTS
  - DAIRIES

EnerFlo HEAT RECOVERY SYSTEMS

ENERFLO HEAT RECOVERY UNITS ARE INSTALLED IN THE HOT GAS LINE BETWEEN THE COMPRESSOR AND CONDENSER OF A REFRIGERATION, AIR CONDITIONING, OR HEAT PUMP SYSTEM. WATER CIRCULATED THROUGH THE ENERFLO UNIT PICKS UP THE WASTE " SUPERHEAT " OF THE SYSTEM; HEAT NORMALLY REJECTED INTO THE ATMOSPHERE AT THE CONDENSER. THE HOT WATER IS TRANSFERRED TO A STORAGE TANK OR DIRECTED INTO THE HOT WATER SUPPLY.

HOW MUCH HOT WATER WILL BE PROVIDED? THE ANSWER DEPENDS ON TWO FACTORS:

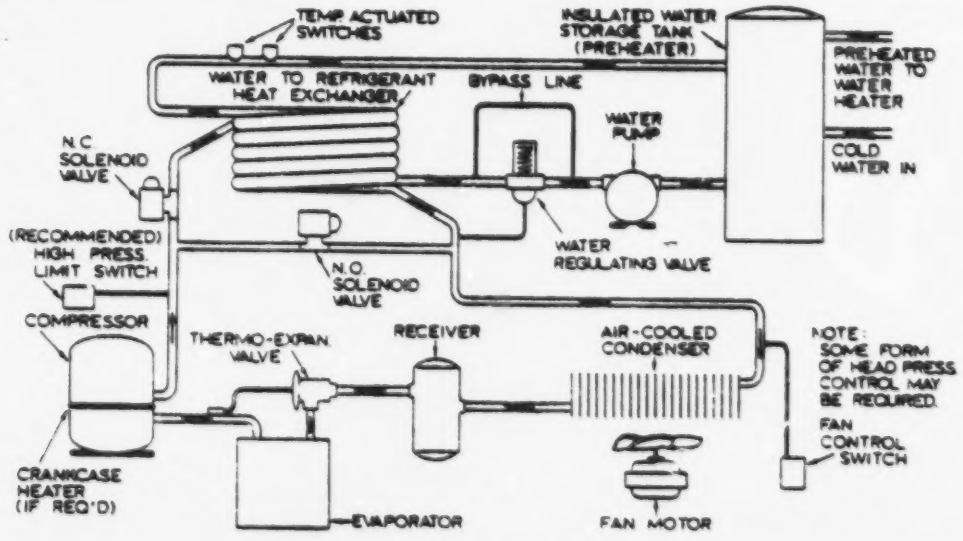
- THE SIZE OF THE REFRIGERATION, AIR CONDITIONING OR HEAT PUMP SYSTEM, AND,
- THE NUMBER OF HOURS PER DAY THE SYSTEM IS IN OPERATION.

BASED ON A 70°F (39°C) TEMPERATURE RISE, AN ENERFLO SYSTEM WILL PROVIDE FROM 5 TO 8 GALLONS (23 TO 36 LITRES) OF HOT WATER PER TON OF REFRIGERATION OR AIR CONDITIONING FOR EVERY HOUR OF OPERATION. FROM A TEN TON SYSTEM, ONE MAY EXPECT FROM 50 TO 80 GALLONS (230 TO 360 LITRES) OF WATER TO BE RAISED FROM, SAY, 70°F (21°C) TO 140°F (60°C) FOR EVERY HOUR THE SYSTEM IS IN OPERATION. ON AN INDUSTRIAL/COMMERCIAL APPLICATION WITH A 100 TON REFRIGERATION SYSTEM, AN ENERFLO UNIT CAN PRODUCE UP TO 800 GALLONS (3600 LITRES) OF HOT WATER PER HOUR; 6400 GALLONS (29,000 LITRES) DURING AN EIGHT HOUR SHIFT.

IN ADDITION TO " FREE " HOT WATER THE DESUPERHEATING EFFECT OF AN ENERFLO WILL REDUCE OPERATING PRESSURES, THEREBY INCREASING THE EFFICIENCY AND EXTENDING THE LIFE OF THE REFRIGERATION OR AIR CONDITIONING SYSTEM.

RESIDENTIAL MODELS ARE AVAILABLE FOR USE WITH 1 1/2 TO 4 TON RESIDENTIAL SPLIT SYSTEM AIR CONDITIONERS AND WITH 2 TO 5 TON HEAT PUMPS. PACKAGED COMMERCIAL MODELS FOR USE IN 5 TO 110 TON REFRIGERATION OR AIR CONDITIONING SYSTEMS ARE ALSO AVAILABLE.

ENERFLO HEAT RECOVERY SYSTEMS ARE SIMPLE, EASY TO INSTALL AND SERVICE AND INEXPENSIVE TO PURCHASE. PAYBACK GENERALLY RANGES FROM ONE TO FOUR YEARS ON COMMERCIAL APPLICATIONS. WHEN USED WITH A RESIDENTIAL SPLIT SYSTEM AIR CONDITIONER OR A HEAT PUMP, PAYBACK WOULD LIKELY BE LONGER.



TYPICAL AIR-COOLED FLOW DIAGRAM

KeepRite

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MADE IN CANADA

Due to KeepRite's policy of continuous product improvement, the manufacturer reserves the right to make changes without notice.

Printed in Canada

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APPENDIX D

BEFORE AND AFTER

REPRESENTATIVE YEARS

ENERGY AND DOLLARS

ELECTRICITY REPRESENTATIVE YEAR TABLE printed: 02/08/85
BASED ON MONTHLY PROFILE
FROM 12/83 TO 11/84

PROJECT: 50012 RESTIGOUCHE GALLERY 25139001

MONTH	TOTAL COST	DEMAND kW	POWER FACTOR %	CONSUMPTION kWh	LOAD FACTOR %	HEATING D-DAYS (18 C)	COOLING D-DAYS (13 C)
JANUARY	$172	.0	---	2,061	0.0	1018.5	0.0
FEBRUARY	$169	.0	---	2,021	0.0	719.5	0.0
MARCH	$200	.0	---	2,421	0.0	757.4	0.0
APRIL	$184	.0	---	2,208	0.0	481.4	0.0
MAY	$209	.0	---	2,533	0.0	294.8	0.0
JUNE	$202	.0	---	2,438	0.0	133.5	0.0
JULY	$261	.0	---	3,195	0.0	17.5	0.0
AUGUST	$195	.0	---	2,359	0.0	23.4	0.0
SEPTEMBER	$170	.0	---	2,032	0.0	214.1	0.0
OCTOBER	$189	.0	---	2,271	0.0	386.0	0.0
NOVEMBER	$182	.0	---	2,189	0.0	534.5	0.0
DECEMBER	$197	.0	---	2,377	0.0	850.7	0.0
	$2,330			28,105		5431.1 ~~4876.6~~	0.0

THE CONSUMPTION COSTS ARE CALCULATED ACCORDING TO RATE : B72 (01 - 84)

ELECTRICITY REPRESENTATIVE YEAR TABLE
BASED ON MONTHLY PROFILE
FROM 12/83 TO 11/84

printed: 02/08/85

PROJECT: 50011 RESTIGOUCHE GALLERY

MONTH	TOTAL COST	DEMAND kW	POWER FACTOR	CONSUMPTION kWh	LOAD FACTOR	HEATING D-DAYS (18 C)	COOLING D-DAYS (13 C)
JANUARY	$609	.0	----	8,387	0.0	1018.5	0.0
FEBRUARY	$528	.0	----	7,172	0.0	719.5	0.0
MARCH	$589	.0	----	8,240	0.0	757.4	0.0
APRIL	$368	.0	----	4,860	0.0	481.4	0.0
MAY	$420	.0	----	5,278	0.0	294.8	0.0
JUNE	$474	.0	----	6,222	0.0	133.5	0.0
JULY	$20	.0	----	153	0.0	17.3	0.0
AUGUST	$90	.0	----	1,127	0.0	23.4	0.0
SEPTEMBER	$119	.0	----	1,574	0.0	214.1	0.0
OCTOBER	$211	.0	----	2,557	0.0	386.0	0.0
NOVEMBER	$315	.0	----	3,868	0.0	534.5	0.0
DECEMBER	$630	.0	----	12,612	0.0	850.7	0.0
	$4,592			61,869		5431.1 ~~4870.6~~	0.0

THE CONSUMPTION COSTS ARE CALCULATED ACCORDING TO RATE : M71 (01 - 84)

ELECTRICITY REPRESENTATIVE YEAR TABLE
BASED ON MONTHLY PROFILE
FROM 04/82 TO 03/83

printed: 02/08/85

PROJECT: 50012 RESTIGOUCHE GALLERY 25139001

MONTH	TOTAL COST	DEMAND kW	POWER FACTOR %	CONSUMPTION kWh	LOAD FACTOR %	HEATING D-DAYS (18 C)	COOLING D-DAYS (13 C)
JANUARY	$293	.0	----	3,599	0.0	873.0	0.0
FEBRUARY	$223	.0	----	2,708	0.0	791.0	0.0
MARCH	$228	.0	----	2,774	0.0	661.0	0.0
APRIL	$215	.0	----	2,607	0.0	534.0	0.0
MAY	$176	.0	----	2,115	0.0	284.0	0.0
JUNE	$195	.0	----	2,356	0.0	152.0	0.0
JULY	$269	.0	----	3,296	0.0	41.0	0.0
AUGUST	$219	.0	----	2,662	0.0	119.0	0.0
SEPTEMBER	$204	.0	----	2,469	0.0	188.0	0.0
OCTOBER	$198	.0	----	2,396	0.0	484.0	0.0
NOVEMBER	$188	.0	----	2,267	0.0	552.0	0.0
DECEMBER	$192	.0	----	2,310	0.0	787.0	0.0
	$2,600			31,559		5466.0	0.0

THE CONSUMPTION COSTS ARE CALCULATED ACCORDING TO RATE : R72 (01 - 84)

ELECTRICITY REPRESENTATIVE YEAR TABLE printed: 02/08/85
BASED ON MONTHLY PROFILE
FROM 04/82 TO 03/83

PROJECT: 50011 RESIDENCE GALLERY

MONTH	TOTAL COST	DEMAND kW	POWER FACTOR %	CONSUMPTION kWh	LOAD FACTOR %	HEATING D-DAYS (18 C)	COOLING D-DAYS (13 C)
JANUARY	$879	.0	-----	13,517	0.0	873.0	0.0
FEBRUARY	$785	.0	-----	11,045	0.0	791.0	0.0
MARCH	$2,502	.0	-----	37,998	0.0	661.0	0.0
APRIL	$457	.0	-----	5,920	0.0	534.0	0.0
MAY	$150	.0	-----	1,780	0.0	284.0	0.0
JUNE	$113	.0	-----	1,288	0.0	152.0	0.0
JULY	$102	.0	-----	1,170	0.0	41.0	0.0
AUGUST	$110	.0	-----	1,347	0.0	119.0	0.0
SEPTEMBER	$102	.0	-----	1,178	0.0	188.0	0.0
OCTOBER	$241	.0	-----	2,930	0.0	484.0	0.0
NOVEMBER	$337	.0	-----	4,152	0.0	552.0	0.0
DECEMBER	$363	.0	-----	4,465	0.0	787.0	0.0
	$6,140			85,690		5466.0	0.0

THE CONSUMPTION COSTS ARE CALCULATED ACCORDING TO RATE : B71 (01 - 84)

ELECTRICITY REPRESENTATIVE YEAR TABLE
BASED ON MONTHLY PROFILE
FROM 11/82 TO 10/83

Printed: 02/08/85

PROJECT: 50013 MONCTON MUSEUM

MONTH	TOTAL COST	DEMAND KW	POWER FACTOR %	CONSUMPTION KWH	LOAD FACTOR %	HEATING D-DAYS (18 C)	COOLING D-DAYS (13 C)
JANUARY	$1,342	48.0	----	18,067	50.6	706.0	0.0
FEBRUARY	$1,151	48.0	----	16,216	50.3	716.0	0.0
MARCH	$1,222	48.0	----	17,664	49.5	602.0	0.0
APRIL	$1,316	64.0	----	19,224	41.9	395.0	0.0
MAY	$1,455	72.0	----	18,966	35.4	244.0	0.0
JUNE	$2,121	80.0	----	31,401	54.5	83.0	0.0
JULY	$2,438	80.0	----	37,870	63.6	25.6	0.0
AUGUST	$2,656	88.0	----	41,171	62.9	40.5	0.0
SEPTEMBER	$2,403	76.0	----	37,734	69.0	110.8	0.0
OCTOBER	$1,971	72.0	----	29,501	55.1	313.9	0.0
NOVEMBER	$1,342	72.0	----	18,661	32.1	447.0	0.0
DECEMBER	$1,193	40.0	----	18,225	61.2	641.0	0.0
	$20,610			302,900		4384.8	0.0

THE CONSUMPTION COSTS ARE CALCULATED ACCORDING TO RATE : R72 001 - 300

OIL & REFRIGERATION BAR TABLE printed: 07/08/85
BASED ON MONTHLY PAYBILL
FROM 11/82 TO 10/83

PROJECT: [illegible]

MONTH	BILLED COST	[illegible]	[illegible]	HEATING DEGREE DAYS (65 F)	COOLING DEGREE DAYS (70 F)
JANUARY	$1,[illegible]	[illegible]	1,242	[illegible]	0.0
FEBRUARY	$1,[illegible]	[illegible]	1,211	[illegible]	0.0
MARCH	$1,[illegible]	[illegible]	1,225	[illegible]	0.0
APRIL	$1,[illegible]	[illegible]	1,289	595.0	0.0
MAY	$2,[illegible]	[illegible]	1,856	[illegible]	0.0
JUNE	$1,416	4,597	1,011	63.0	0.0
JULY	$1,492	[illegible]	1,291	[illegible]	0.0
AUGUST	$2,117	[illegible]	1,509	46.0	0.0
SEPTEMBER	$2,046	[illegible]	1,461	[illegible]	0.0
OCTOBER	$0	[illegible]	0	0.0	0.0
NOVEMBER	$[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
DECEMBER	$[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	$19,733	60,821	17,279	[illegible]	0.0

THE CONSUMPTION COSTS ARE CALCULATED ACCORDING TO RATE : $.308/KWH / LIMES (85-01)

ELECTRICITY REPRESENTATIVE YEAR TABLE — printed: 02/08/85
BASED ON MONTHLY PROFILE
FROM 12/83 TO 11/84

PROJECT: 50013 MONCTON MUSEUM

MONTH	TOTAL COST	DEMAND kW	POWER FACTOR %	CONSUMPTION kWh	LOAD FACTOR %	HEATING D-DAYS (18 C)	COOLING D-DAYS (12 C)
JANUARY	$2,492	.0	----	43,447	0.0	837.6	0.0
FEBRUARY	$1,940	.0	----	33,241	0.0	622.2	0.0
MARCH	$1,994	.0	----	34,205	0.0	708.3	0.0
APRIL	$1,582	.0	----	26,567	0.0	484.1	0.0
MAY	$1,478	.0	----	24,623	0.0	240.0	0.0
JUNE	$2,727	.0	----	47,808	0.0	121.1	0.0
JULY	$4,002	.0	----	71,488	0.0	8.5	0.0
AUGUST	$4,108	.0	----	73,387	0.0	15.2	0.0
SEPTEMBER	$2,628	.0	----	45,966	0.0	171.2	0.0
OCTOBER	$1,948	.0	----	25,932	0.0	343.8	0.0
NOVEMBER	$1,700	.0	----	28,747	0.0	663.8	0.0
DECEMBER	$2,324	.0	----	40,339	0.0	744.5	0.0
	$28,522			495,723		4770.1	0.0

THE CONSUMPTION COSTS ARE CALCULATED ACCORDING TO RATE : 871 (01 - 84)

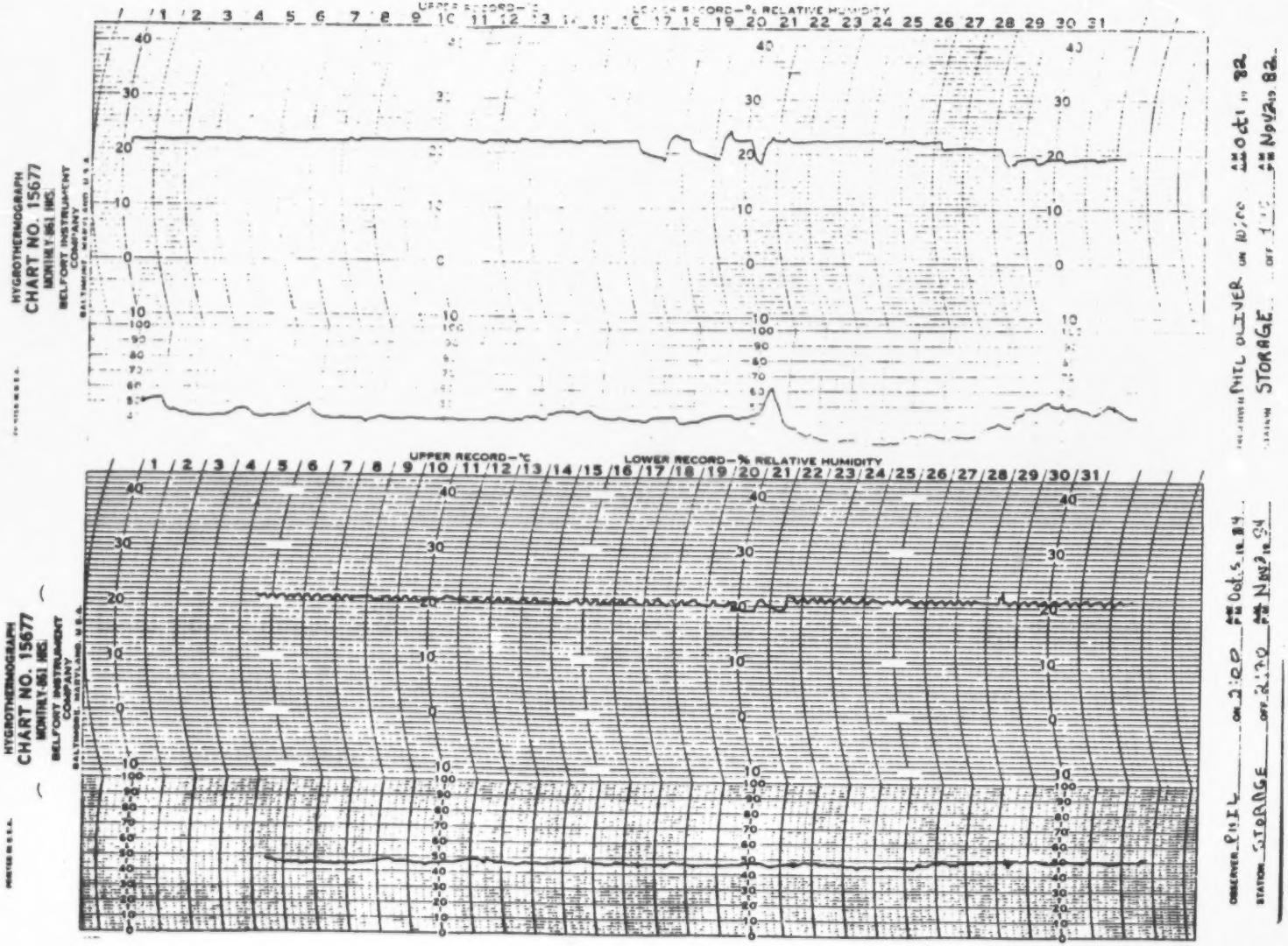
APPENDIX E

BEFORE AND AFTER

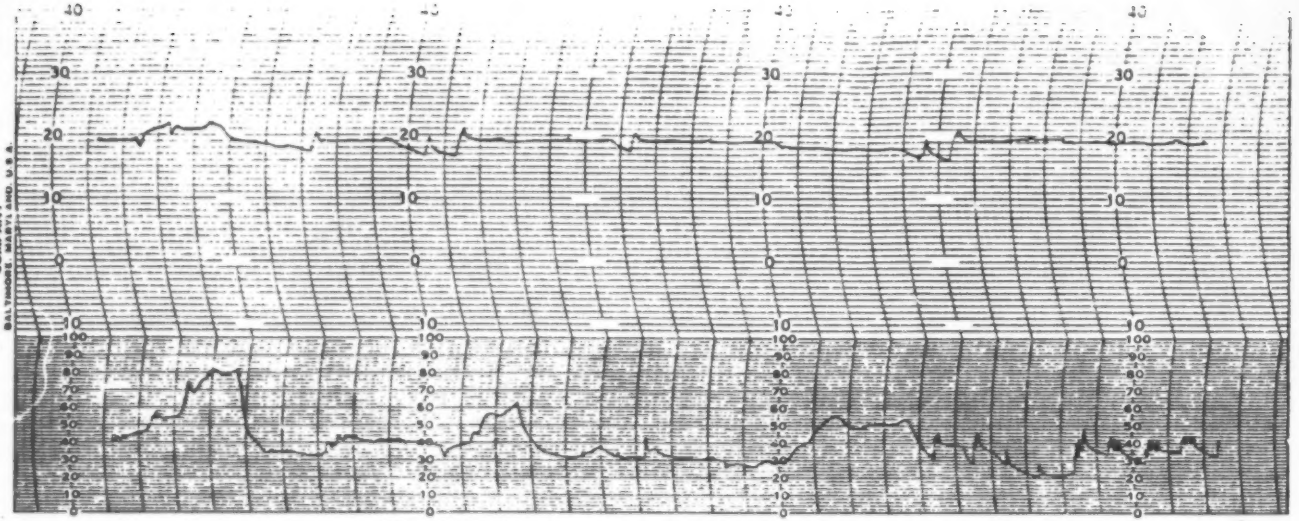
TEMPERATURE AND RELATIVE HUMIDITY

SAMPLES

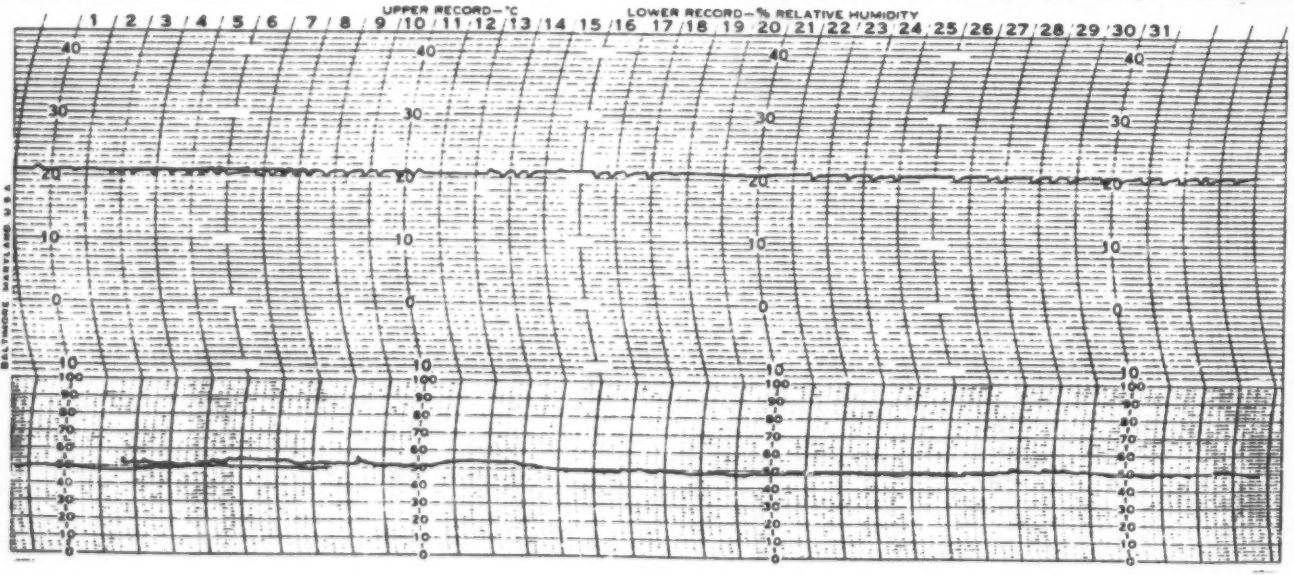
MONCTON MUSEUM


HYGROTHERMOGRAPH
CHART NO. 15677
MONTHLY 861 HC
BELFORT INSTRUMENT COMPANY
UPPER RECORD—°C
LOWER RECORD—% RELATIVE HUMIDITY
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
OBSERVER PHIL OLIVER ON 8:00 AM Oct 31 82
STATION STORAGE OFF 8:30 AM Nov 2 82
BEFORE
HYGROTHERMOGRAPH
CHART NO. 15677
MONTHLY 861 HC
BELFORT INSTRUMENT COMPANY
UPPER RECORD—°C
LOWER RECORD—% RELATIVE HUMIDITY
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
OBSERVER PHIL ON 3:00 PM Oct 5 1984
STATION STORAGE OFF 3:30 PM Nov 2 1984
AFTER

MONCTON MUSEUM



BEFORE



AFTER.